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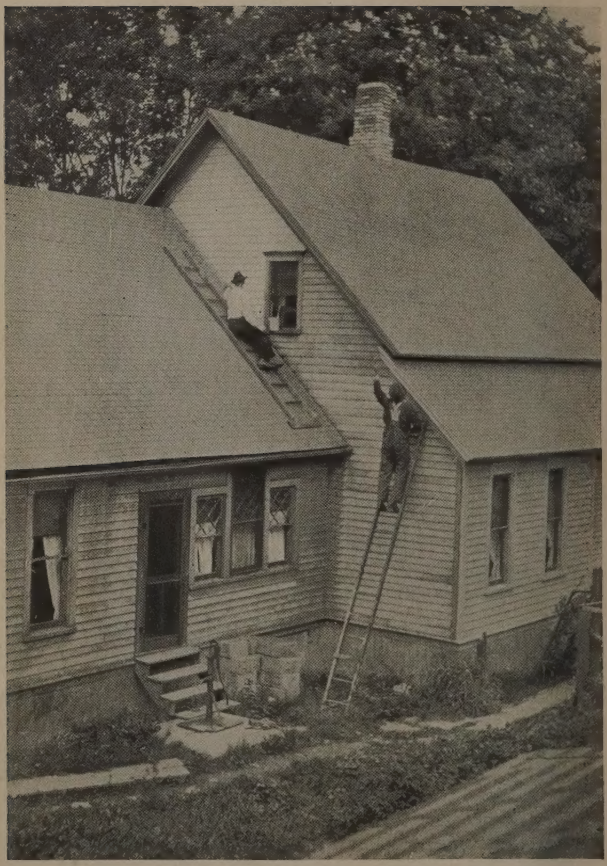

FATHER AND SON PAINTING THEIR OWN HOME IN LEISURE HOURS

The Practical Book of Home Repairs

BY

CHELSEA FRASER

Instructor of Manual Training in the Public Schools of Grand Rapids, Michigan

With Numerous Special Photographs and 225 Drawings by the Author

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To

The Many Boys I Have Taught

To Make Shavings

PREFACE

TWELVE years ago I went into the public schools from the shops of industry, a professional mechanic imbued with the idea that to become even fairly handy with tools one must have the "knack o' tools born in him."

My pet belief—a belief held by practically all mechanics—was knocked higher than a kite before the first year was over. I found that, while it was true that only one boy out of every ten had inherited tool dexterity strongly enough ever to become a skilled artisan, the other nine "average" youngsters made astonishing progress in adapting their unmechanical brains and clumsy hands to wood constructive processes. Not only that, but I found girls and young women equally benefited. In fact, the boys surpassed the girls only in doing heavy construction work. In other respects, such as eagerness to follow instructions, neatness and thoroughness of execution, the gentler sex really excelled.

The discovery set me to thinking. It gave me a new faith in my calling; a colossal faith in what the average boy and man can do with tools if given a little help; a faith no less colossal in what the average girl and woman can do at a "man's job" when she is furnished with directions from those who know.

As time went on, other discoveries came to me. I began to accept a good many invitations to take dinner at the homes of my students. There I met mother and dad, of course. Naturally, too, they praised manual

training in the public schools, and told me how proud they were of the "pretty little things Johnnie had brought home."

Then dad said, half-apologetically: "Wish I had had Johnnie's opportunities when I was a lad. In my day there was no manual training. Why, the only way I can drive a nail without hitting my finger is to hold the hammer handle in both hands!"

Then from mother, very wistfully: "Perhaps some day before our Johnnie is through school, they will put other things into manual training besides woodwork. Our door-bell is out of working order half the time, it seems. It would be so nice if Johnnie could only fix that. We often have to wait days for an electrician to come, and his bill is something tremendous."

Then from dad: "There's that stopped-up lavatory bowl up-stairs. Now, if Johnnie knew as much about plumbing as he does about woodworking, he and I could clear out that obstruction in less than five minutes; eh, son?"

"But we don't get that in manual training," lamented Johnnie, with a shy look my way. "It would be lots of fun, dad, to fix up things around here, only I can't. All I know is woodworking."

"Then probably you can tell me how to loosen up that stuck window in your room; I'm blessed if I know," said dad.

"I guess it ought to be planed, but I don't know how to get the thing out," admitted Johnnie. "We don't study windows."

"You know how to break 'em, though," reminded dad, with a mischievous grin. "Remember that baseball you knocked through the big front glass in the

house next door last week? If you could have replaced that new glass yourself, your bank account would have been considerably fatter."

"I guess it would pay us all to be handy around home here," agreed Johnnie, sagely.

Well, that's the substance of it! I got it from all sides, when I went out into the homes. These average homes of my average students were all crying for fixing up, for simple little repairs here and there which would have made life far more comfortable and convenient had only Johnnie's manual training at school been one dealing with household mechanics instead of cultural woodworking. On the wall, where mother had proudly placed it, hung his latest school product—a laminated breadboard,—too pretty, in her eyes, to be used. Under it was the broken zinc lining of the kitchen-cabinet, shrieking for a little solder skilfully applied to make it once more sanitary and usable. But nobody in that "average" household knew how to wield a soldering copper.

Like Johnnie's multitude of mothers and dads, I began to feel that there must be something wrong with a manual training system that indiscriminately gives only one sort of mechanical development to the average boy. In strictly vocational classes of youths and young men, it is the ideal situation. But in grade schools, where the youngsters are in process of finding their likes and dislikes, abilities and inabilities, there seems no question in my mind but that a program of simplified varied mechanical practices, such as one meets up with in the maintenance of the average household, is the practical and sensible method of putting the thing over.

From various causes, our home life to-day is growing less and less a binding force. We spend comparatively little time around the family hearthstone. We leave the repairs to professional, disinterested workmen, while we attend the play, the lecture, the dance, the club, or scoot around in our motor-car.

We must go back to the home if we are to preserve our once boasted Yankee ingenuity, our gentility, our Lincoln-like honesty, our faith in ourselves. And nothing will help us get there quite so quickly as to take a healthy, loving interest in fixing up our domicile with our very own hands. Our forefathers and foremothers did it, and thrived physically, mentally, and spiritually. Why not we?

To the average family I send this book out as a friend to be consulted whenever a repair or replacement comes up which seems to puzzle. It covers almost every conceivable household fix-it need, and the methods recited are short, simple, and practical, being such as any expert workman in each line would adopt were he to be called into service. In all instances, costly outfits of tools have been avoided, so that those recommended will not be difficult for the home-owner to purchase.

All in all, if the present book helps grade manual training to a quicker finding of its true office through popularizing industry in the home by dad, mother, Johnnie, and Sister Sue, I shall feel more than amply repaid.

CHELSEA FRASER.

Grand Rapids, Mich., April, 1925.

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The Practical Book of Home Repairs

I

FITTING UP A WORK CORNER

Most homes are provided with some spot which can be used by the enterprising owner as a shop or work corner, for doing such tool processes as are necessary in making repairs upon the premises and for devising new constructions which may appeal to him.

The Best Location for the Workbench is one that is both dry and well-lighted. Dampness will rust tools if it reaches them; therefore, if you must choose a basement for your work corner, it will be best to keep the tools wrapped in newspapers or cloths when they are not in use. A window close to the bench provides the ideal light; lamps, no matter how strong, are hard upon the eyesight. Sometimes a ground-floor space can be secured in the house—an ideal condition. Again, the attic can be used. And very often the garage or the barn will supply a first-class location, and the installation of a small heating stove will make it possible to work in such detached buildings all winter long.

Buying a Workbench is by far the easiest way of acquiring one—if you have the money. Good used benches can often be picked up by watching the want columns of the local newspapers, by inserting an ad-

vertisement, or by visiting the second-hand stores. New benches cost from $7.00 to $50.00, and are obtainable either from local hardware dealers, or from bench manufacturers whose addresses they will furnish, or from mail-order houses in the larger cities.

The workbench illustrated in *Fig. 1* is a very strong, serviceable structure for home use. It has steel legs,

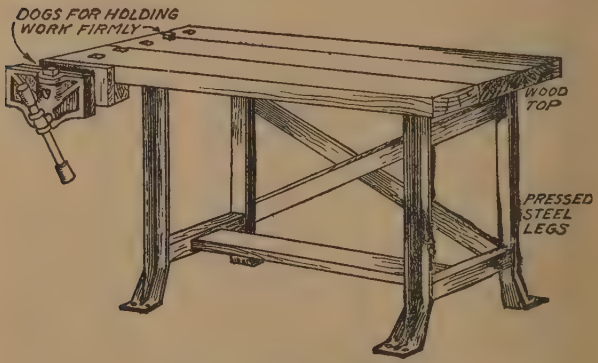


Fig. 1. A "Store" Workbench.

wood bracing, hardwood top, and a practical type of vise. Such a bench can be purchased for about $9.00. It has no tool drawer, but the handy man, woman, or boy, can easily construct such a device out of an old packing box and fasten it on slides to the under side of the bench top. The drawer shown in *Fig. 3* will offer helpful suggestions in designing such a tool receptacle.

A Home-made Workbench (*Figs. 2* and *3*) will appeal to all those who are fairly proficient with tools and who wish to enjoy the deep pleasure which always

comes out of creation. Some expense, too, will be saved, which is a worth-while consideration.

Various types of benches can be made at home, without great effort, some of which will be better adapted to certain spaces than others. For instance, it

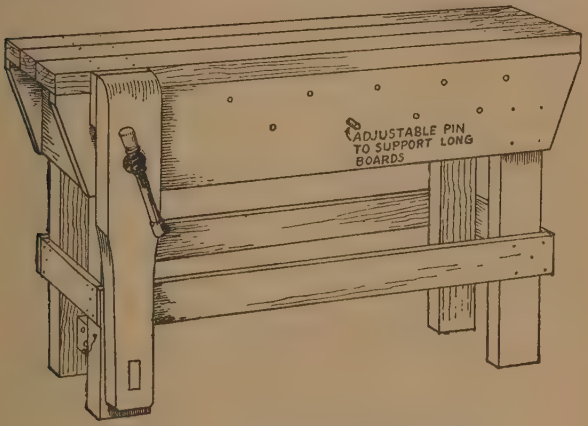


Fig. 2. A Home-Made Workbench.

may be possible, by nailing a board to the wall and resting the inner side of the bench top upon that, to get along by making only two legs as supports for the outer side of the bench top. Moreover, if the bench can be set in a corner, quite often only one leg will be required, for you can cleat under the top at one end as well as along one side. In either event, the cleat type of construction makes a very rigid one, and saves a lot of lumber, for only a little bracing is required, most of the wood used being in the bench top itself.

Every workbench should have a solid, level top, and a good vise. It should stand at a convenient height for the workman. A height of 30 inches is about right for a half-grown boy; a man's requirements is 32 inches. The top should be made up of narrow

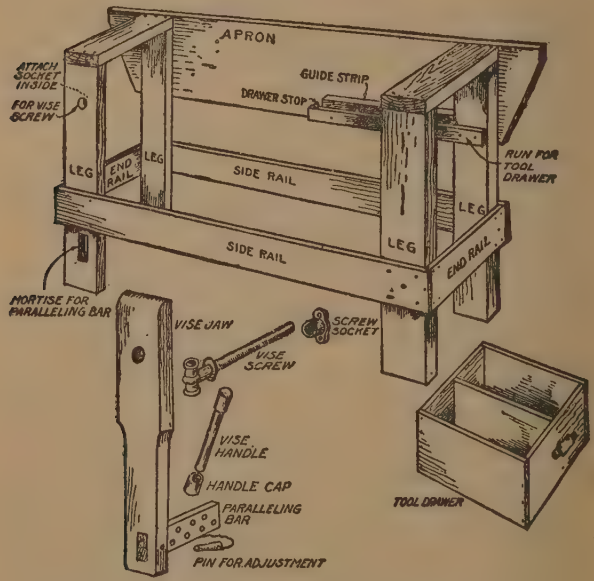


Fig. 3. Details of the Home-Made Workbench.

hardwood boards, not less than ¾ inch thick, 1½ inches preferred, with all edges close-fitting; wide boards will eventually warp. Softwood boards can be substituted, but will not wear as long. The vise should possess a metal screw; the outer jaw should be faced

with wood, to prevent injury to work and tools, and should come up squarely against the apron or face of the bench. In this connection, a substantial carpenter's type of vise can be constructed from the plans shown in *Fig. 3*.

In the same drawing, details are given for making the four-legged workbench shown in *Fig. 2*. The lumber can be secured of almost any local lumber dealer. White pine, Norway pine, basswood, poplar, or cypress will do for all parts except the top and vise, which should be made of birch or maple.

The legs can be made out of 2 by 4's, although 2 by 6's will give greater strength. Determine the height of bench you want, subtract the thickness of the top, and the result will be the length of legs wanted. The width of the bench will depend upon your space conditions, but a good width is 20 inches. The length will also be affected, perhaps, by the situation, although 6 feet is none too great if there is room for it.

The two apron pieces (where two are desired) are 9 or 10 inches wide, and are beveled off at the ends. These are nailed to the upper sides, supporting the upper portion of the legs, while bracing boards 4½ inches wide are nailed below and across the ends, as shown in *Fig. 3*.

The top boards, as stated before, should be of hardwood. None should be wider than 5 inches, and close joints should be made. Do not try to drive nails through hardwood without first boring a small hole which will just neatly receive the nail without admitting the head itself.

To the apron of the bench, where the vise jaw will

rest in clamping up work, attach a hardwood block of the same thickness as the bracing strip at the bottom.

The vise jaw is shaped as shown. It should be made of birch or maple 1½ inches thick, and long enough to come to the top of the bench while its lower end falls short of the floor about 1 inch. Its lower portion is mortised to receive the guidebar, which is fastened in with glue and a nail, after boring several ¾-inch holes through the bar for receiving the wooden set-pin. This arrangement is for keeping the lower end of the jaw always parallel with the upper end when the latter portion is bearing upon the work. A matching mortise is cut through the leg of the bench, to loosely admit the guidebar, and the pin is withdrawn and inserted from the rear.

A good steel vise-screw can be bought at a hardware store for about 75 cents. It is supplied with a flanged nut. In fitting the screw, first push the vise jaw up against the bench apron, with the guidebar in place, then bore through the jaw, apron and bench leg a hole large enough to admit the screw. Screw the handle flange to the vise; likewise screw the flanged nut in place under the bench. A bought handle, or a home-made one, will complete the vise.

Holes bored in the apron of the bench will be found a great convenience in supporting the free ends of long boards whose edges must be planed. Make a pin to fit the holes, and stick it into the hole that will serve to bring it at the proper height for sustaining the work.

The tool-drawer is so simple to make that the illustrations will be sufficient explanation. The parti-

tion is put in after the framework or sides are nailed together. An old window-sash pull can be used for a handle, or a regulation pull can be purchased for 10 cents.

To finish the bench, apply two or three coats of orange shellac to all wooden parts except the face of the vise jaw and the face of the top. Rub boiled linseed oil into these, then wipe them off clean.

A Detachable Metal-worker's Vise, of a small size, ought to be secured. This clamps to any convenient place along the end or edge of the bench top, or to a shelf, and is quite essential for holding metal pieces while you are working upon them with tools. Metal objects in a wooden vise will bruise its face and destroy its efficiency. A medium-sized vise, of the kind shown in *Fig. 94,* Chapter IX, will cost $2.00.

Metal Vise Faces, however, can be made at home, and applied to a wood-worker's vise if you do not care to purchase a special vise for doing your metal jobs. Get a section of lead pipe from a dealer in plumbing supplies. Cut this longitudinally in two with a hack-saw or coldchisel, flatten both the plates, and screw them to the faces of the vise jaw and bench so the screw heads will not project. The plates may be removed in a moment when woodwork jobs are to be done.

A Bench Grinding Wheel is a necessity if you are going to keep your tools as sharp as they should be kept. The wheel clamps to the bench, and is driven by a crank. They come in various sizes, but you will be wise to choose between the extremes. Such a grinder, illustrated in *Fig. 4,* sells for about $6.00.

A Vise Planing Stop, home-made, is shown in *Fig. 5.* It consists merely of a piece of ⅜-inch hardwood, 5 inches wide, and 9 inches long, across one end of which is fastened, by countersunk screws, a thicker strip. This planing stop cannot be bought. It is useful for clamping in the vise, across the bench top, to pre-

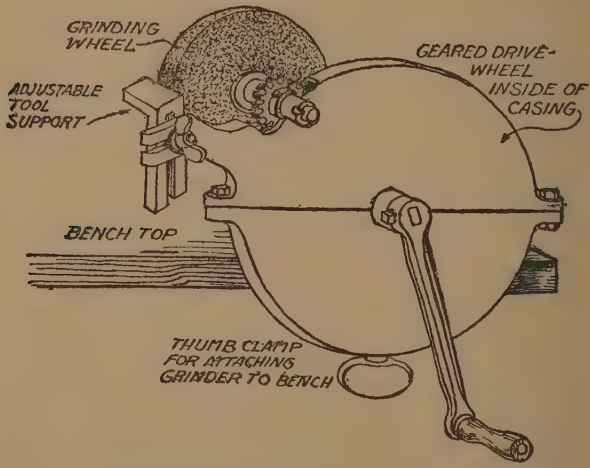


Fig. 4. This Grinding Wheel Attaches to the Bench Top.

vent boards from sliding when being planed on their sides.

A Bench-top Planing Stop can be secured from dealers for a price as low as 50 cents. They come in various forms, and most bought benches are equipped with them. These planing stops fit in flush with the bench top, and possess an adjustable stud which can be raised and lowered to accommodate almost any thickness of stock being worked upon. For a home-

made bench, you can make your own stop by making a mortise in the bench top and fitting into it a stud of hardwood about 3 inches long. There should be sufficient friction to maintain the stud in any position desired. It is set to various heights by tapping it with a hammer, from above and underneath the bench. When wear makes it useless, all you have to do is spend a few minutes cutting out another stop from scrap wood. (See *Fig. 5.*)

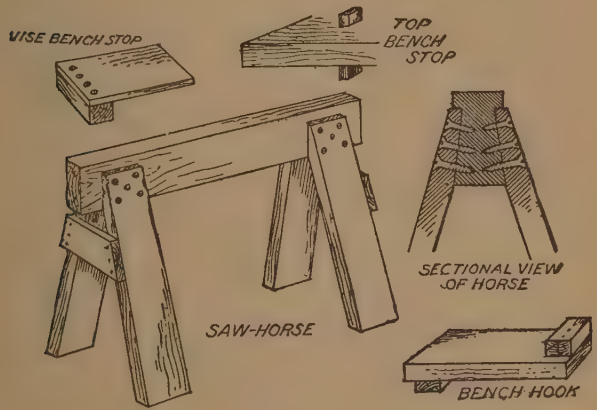


Fig. 5. Workshop Bench Accessories.

A Benchhook is another necessity for the home workshop, and a good one is shown in *Fig. 5.* This hooks over the edge of the bench, or is sometimes held in the vise, and is used to assist the free hand in holding narrow pieces of stock which are being sawed with a back-saw. It can be made of ¾-inch softwood. Make the table-piece 5 inches wide and 7 inches long.

The end blocks are 2 inches wide and reach across each end to within 1 inch of the right-hand edge of the table. They are nailed in place, and the nail heads set.

A Pair of Sawhorses are convenient for laying large boards upon for sawing out smaller pieces. Makeshifts, such as old chairs with their backs sawed off, boxes, *et cetera,* can be used in the place of sawhorses, but as the latter are not difficult to make, you are advised to make a couple of the professional articles. A 2 by 4, cut 24 inches long, will make a spine for a horse. Have the legs about 1¼ inches thick, 5 inches wide, and 20 inches long. After the legs are beveled off at their upper ends, cut out the spine to receive them, and then screw them in place, so that they will have a spread of approximately 12 inches at the bottom.

The Outfit of Tools you will need for home work will embrace both wood-working and metal-working instruments, for many repair jobs along both lines will ultimately manifest themselves, and you must be prepared to meet and solve them if you are going to make a complete success of your venture in amateur mechanics. Not only this, but other specialized tools may be required for some household demands. Such tools, however, will not cost much, compared to the value they render, and will be listed in the chapters with which they are rightfully concerned, rather than with the present chapter, which is to deal exclusively with wood-working and metal-working equipment.

An Outfit of Wood-working Tools, for our purpose, ought to include the following:

1 6-oz. bradhammer,
1 16-oz. bell-face hammer,
1 11-point cross-cut saw,
1 7-point rip saw,
1 12-inch back saw,
1 10-inch keyhole saw,
1 12-inch jack plane,
1 9-inch try-square,
1 framing-square,
1 2-fold 24-inch rule,
1 maple yardstick,
1 medium screwdriver,
1 small screwdriver,
1 scratch awl,
1 pencil compass,
1 ratchet brace,
1 single-speed handdrill,
1 each, round-shank drills, 1/32, 1/16, 3/32, 1/8, 5/32, 3/16,
1 each, auger-bits, 1/4, 3/8, 1/2, 3/4, 1 inch,
1 spokeshave,
1 each, chisels, 1/4, 1/2, 1 inch,
1 each, gouges, 1/2, 1 inch,
1 box chisel,
1 small level,
1 adjustable bevel,
1 steel scraper,
2 quilting-clamps,
1 pr. cutting-pliers,
1 medium-grit oilstone,
1 medium slipstone,
1 copper oil can,
1 1/16-inch nailset,
1 marking-gauge,
1 bit file,
1 cabinet file,
1 saw file,
1 hank No. 2 chalk line.

Every home will probably already possess one or more of the tools named in the foregoing outfit, and this will decrease the number to be purchased. It is best to buy high-grade tools and to get them singly rather than as an outfit. You can buy a few of these at a time, if necessary—the most needed first,—and in that way you will scarcely notice the aggregate expenditure. A reliable hardware store in your own town is usually the best place to go, although a few of the largest national mail-order houses can be relied on to render honest service. If you are not acquainted with the leading brands of tools, ask some carpenter or cabinetmaker to tell you. To publish a few names in this volume would be unfair to the other reputable manufacturers of tools whose names, taken as a whole, would require more space than can be spared.

From $25.00 to $50.00 will purchase a very fair equipment of wood-working tools for home work.

Special tools required for metal-work will be found listed in Chapter IX.

The Care of Tools is an important factor in keeping them in prime condition for work. They should not only be kept sharp, but always free from dampness, and be conveniently racked, and each tool should be kept in its allotted place.

If your tools do get rusty, immediately clean them with kerosene and emery-paper or kerosene and 2-0 sandpaper.

II

SHARPENING TOOLS AND HOUSEHOLD CUTLERY

To render the best service, all edged tools must be kept sharp. A dull tool is an abomination; instead of cutting freely and leaving a smooth surface, it exhausts us to use it any length of time, and it produces a ragged, uneven surface.

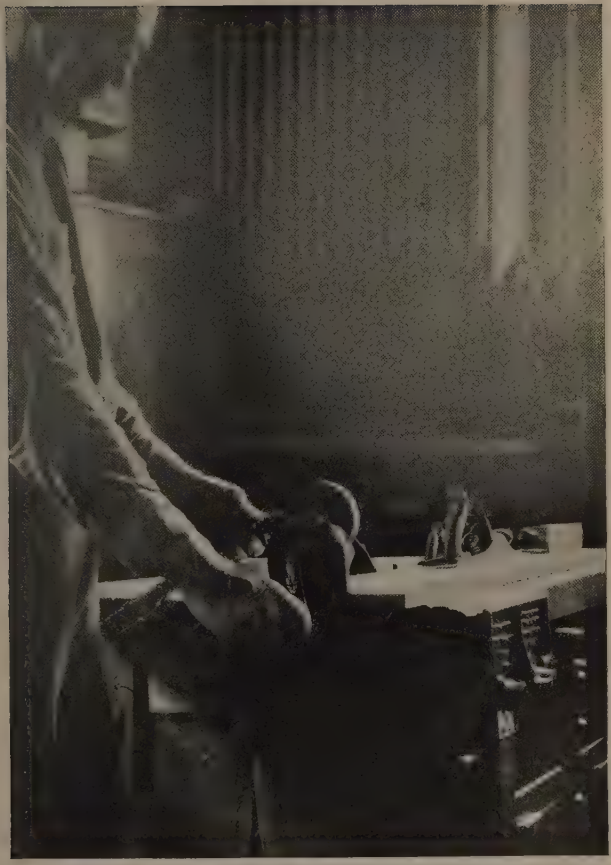
There is really little excuse for any one having dull tools or dull household cutlery about the premises. A small expenditure of from $7.00 to $10.00 will furnish all the equipment required for keeping such tools in first-class condition, and a little practice of the directions contained in this chapter ought to make it possible for the home-owner, or any careful member of his family, to put a keen edge on the worst nicked cutting implement that can be found. It is surprising how soon one can master the use of a grinding wheel and oilstone, and equally surprising, as well as pleasing, how much money one will save in a year's time by calmly ignoring the scissors-grinder's tingling bell in front of the house.

A Grinding Wheel of some sort is needed to make blunt edges thinner, to reshape broken points, and to remove nicks. For this purpose, unless you have a good deal of heavy sharpening to do, such as axes (where a grindstone is advisable), I would advise you to get the type of bench grinder shown in *Fig. 4* of the preceding chapter, a medium size costing in the neighborhood of $6.00.

Some of these wheels are made of emery, others of carborundum, others of different forms of grit composition; but nearly all of them render excellent service. The machines clamp to the bench top or a shelf. They are provided with an adjustable tool rest, used in steadying the tool. The latter is held with the left hand while the crank is turned with the right hand, thus revolving the wheel. The faster the wheel is turned, the faster the cutting will be.

Increased pressure upon the tool will, of course, increase the grinding power; therefore, if you can get another to turn for you while you do the actual guiding of the tool yourself, you will be able to handle the job quicker than if you were the sole operator.

But more weight and force upon the tool means more friction, and more friction means more heat for the tool to stand. Consequently, the operator must be ever watchful, especially if he is bringing his tool down to a thin edge, that he does not overheat it by excessive bearing, for overheating softens the temper of a tool and damages its cutting efficiency. Overheating is manifested by a sudden yellowing of the steel, which turns, faster than I can tell it—if the instrument is not withdrawn—into buff, brown, purple, light blue, and finally dark blue. Each of these colors, in the order named, represents degrees of softening. By the time the dark blue stage is reached the tool is too soft to be useful, without restoring the temper, which is a process with which only an expert in cutlery manufacture should meddle. To guard against "burning" the tool when grinding it, most mechanics have a cup of water handy. Into this the tool is dipped, at



GRINDING A CHISEL

frequent intervals, to cool it off. Do not put water on the wheel.

One of the greatest abuses of grinding wheels is the grooving of the rim surface, and sometimes the side surfaces. This, in a wheel, is mute evidence of the operator's ignorance, likewise of his lack of good common sense. Grooves in a stone render it close to worthless, for tool sections coming over such depressions cannot receive a uniform grinding with other portions in contact with the wheel's grit.

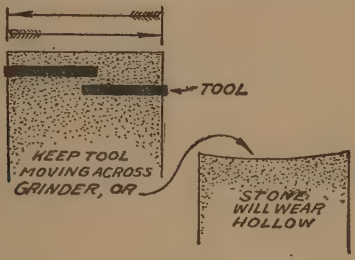


Fig. 6. How to Grind a Tool.

This sad condition of a grinding wheel is due entirely to the fact that the workman was not wise enough to keep his tool moving sidewise, back and forth, across the entire surface of the wheel. If he had done this, he would have maintained a true grinding surface on his wheel, no matter how many small tools he ground upon it. Thus the wheel would not only wear much longer, but would also give perfect service at each operation. In *Fig. 6* we have a graphic illustration of the principles just named. It will pay to give the drawing close scrutiny and consideration before attempting your first grinding job.

Take good care of your grinding wheel. Keep the bearings well oiled and the adjustments tight. Do not use it to grind lead, aluminum, or wood, as such soft products will gum it up and lessen its sharpness of grit.

And last, remember that a grinding wheel is too coarse to finish the cutting edge of anything but a heavy implement like an axe. Its purpose is that of a *shaping* machine only. When the blade is of the desired form and bevel, then the grinder has done its duty, and the finishing—the razor-like keenness that is found in all correctly sharpened tools—is to be attained by applying the instrument to an oilstone of some kind.

An Oilstone, as it is commonly spoken of, is a natural quarried stone, or a composition, whose grit is much finer than that of the common grinding wheel. There are various shapes of oilstones, from that of a disc to that of a rectangle, but most of them are of the last-named form. Of the many kinds manufactured there is no "best," so no particular brand will be recommended here, but it will be well for the householder to purchase a stone of two degrees of grit—one side fine, and the other medium. You should hone the chisels and heavier tools on the medium grit, and hone your pocket knife, mother's scissors, and your razor, on the fine grit. A good oilstone will cost about 60 cents.

Exercise the same care to keep from wearing grooves in your oilstone as you do to keep similar defects from your grinding wheel, moving your tool all over the surface while sharpening. The fact is, a hollow or uneven oilstone might as well be thrown away if you

have to sharpen plane cutters upon it, for they require a very true surface.

Oil for an Oilstone should not be too thick or it will gum up the stone, glazing it so that the grit will not take hold. Common kerosene, kept in a small copper oilcan, is one of the best lubricants you can use, and it has the additional advantages of being inexpensive and readily procurable.

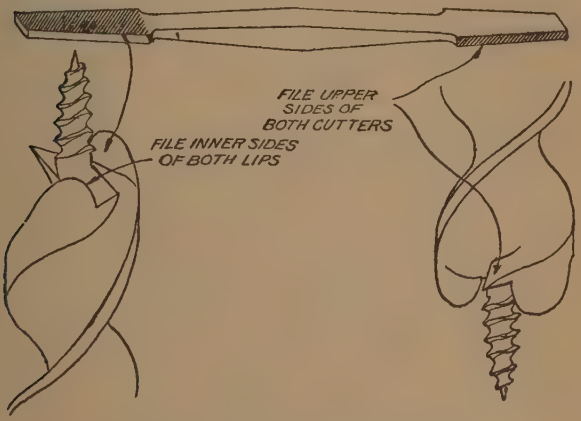


Fig. 7. How to Sharpen an Auger Bit.

A Slipstone is made of similar grit to an oilstone, but its distinguishing characteristics are two rounded edges, one larger than the other. These edges are adapted to fit into the hollows of various sized gouges, for honing them from that side while the oilstone performs the honing act on the rounded side. These stones are smaller and thinner than oilstones. It is common practice to hold the tool stationary while you

move the slipstone—a reversal of the oilstone process. When using a slipstone, oil the tool where the honing is to take place. Slipstones can be bought for 25 cents.

A Bit File is a peculiar-shaped file, as you will note by referring to *Fig. 7*. One will cost about 20 cents. Only the ends are usable. One end has the edges smooth; its sides toothed. The other end has its sides smooth; its edges toothed. Such a file is quite useless except for sharpening auger bits, and there it shines.

A Mill File, 10 or 12 inches long, is required for general sharpening purposes where other appliances will not do the work. Such a file is shown in Chapter IX, *Fig. 94*. It costs about 20 cents.

A Burnisher is a sharpening agent used only in putting an edge on hand scrapers. Burnishers have handles, also a smooth, rod-like blade which comes to a conical point. An investment of 35 cents will procure one, but a very good substitute can be had by using the rounded back of a gouge, as will be explained farther on in this chapter.

So much for the sharpening agents themselves. Now for the method of using them upon tools and household cutting devices.

How to Detect Very Small Nicks in a Tool—nicks which you cannot see, but which, nevertheless, prevent good cutting—is a very easy matter. Just draw your thumb-nail backward along the edge of the tool and your nerves will at once notify your brain if the slightest nick prevails.

A Nicked Pocket Knife is an excellent subject upon which to put your first practice at sharpening. It

is easy to handle, and the principles involved in re-edging it will cover the fundamental grinding and honing processes.

At *A*, of *Fig. 8*, we have a rather sick-looking knife blade—one ready for an operation, if not for the hospital. When nicks are found in any kind of blade, the

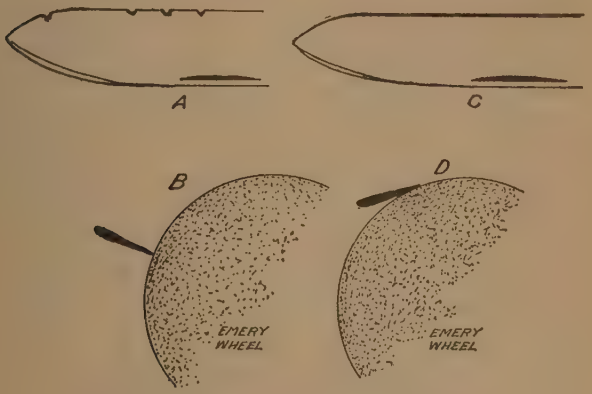


Fig. 8. Grinding a Nicked Knife Blade.

object is to remove them by grinding off the surrounding edge metal until it has come down in line with them, producing once more an uninterrupted, smooth outline. Such a result is attained by holding the nicked edge squarely across the edge of the grinder, as at *B*. Obviously, a very blunt edge will be produced, such bluntness increasing in accordance with the depth of the deepest nick, for that deepest one must be eradicated. (See *C*.)

The next step is shown at *D*. This is the rebeveling of the edge to a very thin condition. To accom-

plish this result, grind first one side and then the other, holding the blade almost flat and maintaining the slant as uniformly as possible. At first you may have to use the tool rest, but as you gain control over your nerves and muscles, it is not at all unlikely that you will prefer to support the tool freely, particularly if you can get a helper to turn the wheel so that you can use both hands in guiding the tool.

The grinder, you will observe upon close inspection, has left quite a rough edge on the knife blade. You now start to remove the raggedness on the oilstone. *Fig. 9* shows some wrong angles for honing the blade; also shows the correct angle. No. 1 is too flat; the

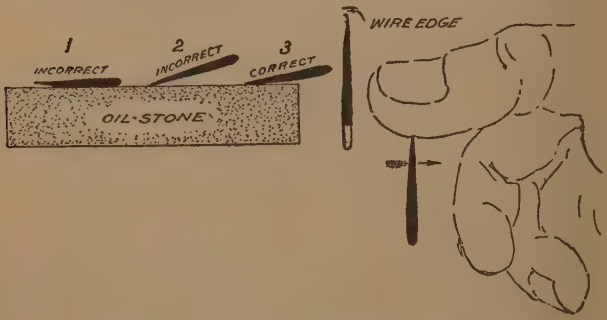


Fig. 9. Honing and Testing an Edged Tool.

edge will not be touched. No. 2 is too strong an angle; the cutting edge receives more than its share of contact and will be honed too bluntly. In No. 3 we have an intermediate angle—the ideal position. Here the cutting edge receives a long bearing, which produces something akin to a very keen condition of blade.

But the real keenness will not come until you have

removed the "wire edge." This is an extremely thin portion of steel, as fine as a spider's web. It is actually the ragged portion of the edge left by the coarse grit of the grinding wheel. As you hone one side of the blade, this wire edge will bend over toward the opposite side—a condition you can recognize if you will drag a thumb down that side. Repeated turnings and honings of each side will soon wear down the wire edge; it will break off, particle by particle, until the wiping of your thumb over both sides will convince you that it is entirely gone.

As a final test of the sharpness of the knife blade, pull your thumb lightly *across* it, as shown in *Fig. 9*. The keenness, if it exists, will be immediately felt. I warn you, however, not to draw a thumb or finger lengthwise, as a cut is sure to result.

A Paring Knife, when dull, is sharpened in much the same manner as the pocket knife just described. The only difference is that, being thinner, it should be held more flatly against the grinder and the oilstone. Do not press too hard or the blade may snap, if it happens to be highly tempered.

A Butcher Knife seldom gets nicked, if mother does not use it for pulling out tacks. But contact with bones soon dulls it, and it will need sharpening. If not very dull, it will not need grinding; merely hone it. If it is quite blunt, apply the grinder until the edge is of the desired thinness, then hone it in the customary manner.

A Bread Knife, if it has a straight cutting-edge, is sharpened in the same manner as a butcher knife, although the grinding is likely to call for a little more

care, owing to the bread knife being somewhat thinner. But if the knife has an escalloped edge, as most of them do, the grinding must all be done on the beveled side, and the corner of the stone used. A slight rocking motion upon the knife will cause the wheel to follow the hollows and rounds. Use a slipstone in honing.

A Carving Knife presents no more difficulties than a butcher knife. Grind both sides of it to a thin condition at the cutting-edge, then apply it to the oilstone for a good honing.

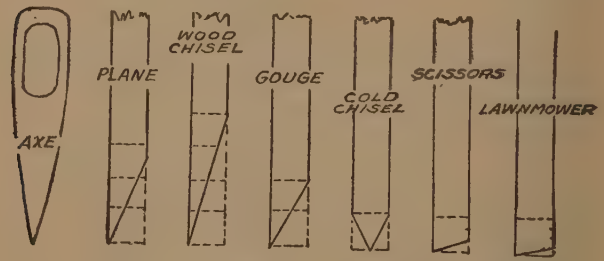


Fig. 10. The Correct Beveling Angles for Various Edged Tools.

A Chisel, if nicked, should first have its nicks ground out by placing its edge squarely against the grinding wheel, as in the case of the pocket knife previously described. If the chisel is blunt, grind it down thin again as you would in rebeveling any other cutting instrument. If it is only dull—which means that nothing more than the keenness is gone—it will not need grinding at all; just hone it long enough to restore its former sharpness.

In rebeveling a chisel for softwood, have the bevel run back about four times the thickness of the blade.

For hardwood, give less bevel—about three times. (See *Fig. 10.*) Remove the bulk of the metal on the rim of the wheel; finish on the side. Hone on the oilstone in the usual manner.

A Coldchisel is a metal-working tool, and therefore gets dull faster than its wood-working brother, the wood chisel. But it has the pleasing quality of being more easily sharpened. Both sides are beveled, as shown in *Fig. 10,* and these bevels are about 45 degrees, running back approximately the thickness of the blade. This tool requires no honing.

A Spokeshave Cutter, when dull, should be removed from the frame by loosening the setscrew. Grind the beveled side back about three times the blade's thickness. Hone in the usual manner of bevel-edged tools.

A Draw Knife is an awkward thing to sharpen on a grinding wheel, on account of its handles. But if you are careful you can perform the job without striking the handles on the revolving wheel, which would be sure to scar them. Grind to a four-times bevel—which means grind back four times the thickness of the blade. As only a small portion of the blade will be bearing upon the stone at one time, you must keep the entire blade moving across the rim of the stone at a uniform angle, removing a little steel each trip, and making enough such trips to reduce the blade, eventually, to the shape and thinness desired.

This tool is also a mean one to hone, owing to those same contrary stick-out handles. Instead of rubbing it back and forth on the oilstone, take the oilstone from its case, oil the blade of the draw knife, and pass the

oilstone up and down along the cutter, while you hold the draw knife on end upon the bench.

A Plane Cutter should not be difficult to sharpen after you have had the experience of putting a spokeshave cutter in tip-top condition. Remove the cutter from the plane by raising the clamping lever that holds it. Loosen the setscrew of the curling iron. Slide back the curling iron about an inch, and reset the screw with the fingers by giving it a quick twist to the right. The cutter's cutting end is then freely exposed, and it is ready to sharpen.

Reference to *Fig. 10* will show you the proper grinding bevel for a plane cutter that is to be used for general purposes; that is, used on both soft and hard wood. If your stock runs largely to soft wood, you will get better results to make the bevel three times instead of the two and one-half times illustrated.

If you have but one plane, grind it with a straight cutting-edge. If you have two planes—a smoothing plane and a jack plane, which is a better situation—grind the jack a trifle rounding before you bevel it, as it will cut faster that way; and use it for a roughing-down tool. Fore planes and jointers should possess straight cutting edges, as they are finishing planes of a most particular kind. These two planes, however, may be dispensed with in the home work corner, as household repair jobs seldom require their use.

A Gouge, although a first cousin to a wood chisel, is by no means as "willing" to be sharpened. This is owing to its curved form, which brings a hollow on one side and a round on the other. Some gouges are beveled on the inside, others on the outside. The in-

side bevel is the most difficult to handle, unless you have a grinding wheel possessing a round rim. Indeed, if your gouge is beveled inside, and if your grinder is flat, about all you can do is to use your slipstone on the inside of the gouge until the metal is down to a thin edge (see *Fig. 11*), then remove the

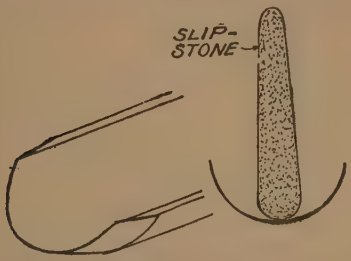


Fig. 11. Honing the Inside of a Gouge on a Slipstone.

wire edge by rolling the gouge's rounded side on the oilstone. (See *Fig. 12.*) If your tool has an outside

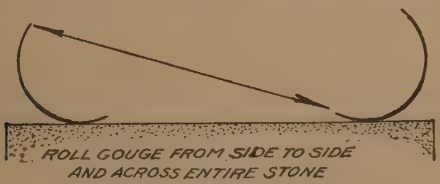


Fig. 12. Honing the Outside of a Gouge.

bevel, grind by rolling the gouge across the rim of the wheel, and finish by doing likewise upon the oilstone.

A Scraper can be sharpened in two ways. One method is to grind the edge to a three-times bevel, from one side only, honing on the oilstone until it is

keen. The other method, illustrated in *Fig. 13,* is done without grinding any bevel at all. First, grind or file the edge perfectly flat, honing it to a smooth condition. (See *A.*) Second, fasten the scraper in the vise, with the edge upward. With a burnisher, or the rounded back of a gouge, turn over both arres of the edge, by

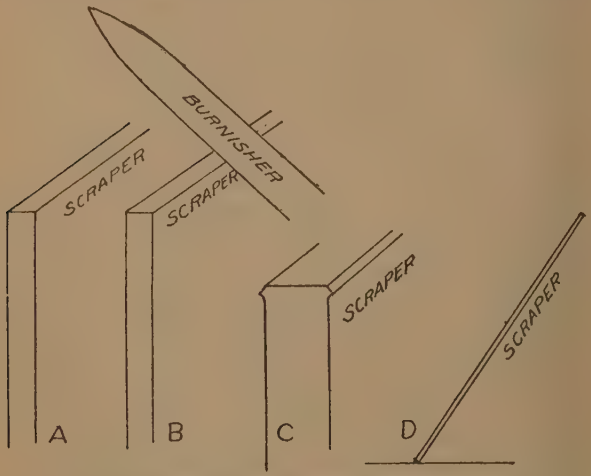


Fig. 13. Steps in Sharpening a Hand Scraper.

pressing hard and pulling the burnisher along at a slight angle. (See *B* and *C.*)

When using the scraper, set it at the proper angle to make the turned edge operate. A little testing will quickly determine this angle. (See *D.*)

Good scrapers can be made from old saw blades. Shape the pieces on the grinding wheel, some of them in curves, so that you can scrape molding and other irregular surfaces.

A Razor, of either the open or safety kind, will be found in nearly every home. You can keep it in first-class condition by honing upon the oilstone and then stropping. Grinding should rarely be resorted to, as few razors get dull enough to require it.

To hone an open-type razor, lay it on the oilstone so that its back touches very lightly. Apply kerosene oil, and gently rub the blade a while with a circular motion, in one spot; then shift to another spot, covering the entire stone, during which you should reverse the sides of the instrument, giving each side its due portion of treatment. Strop painstakingly on your regular razor strop, drawing from heel to toe of the blade, in a diagonal direction. Do not attempt shaving with the instrument until every particle of wire edge has been removed by the stropping process. Should the edge, by repeated honings, become too blunt and require thinning, first grind off a portion of the thick back edge before reducing the thickness of the cutting-edge itself. The cutting-edge is so thin that it will "burn" in the flash of an eye, so you must press very lightly while grinding, and not keep the tool too constantly on the wheel.

To hone a safety-razor blade, hold it on the stone at the same angle the blade has in the frame, and gently work it with a circular motion upon the oilstone. Strop it to remove the wire edge.

Scissors and Shears are mother's and sister's favorite tools, and like every other edged instrument about the home, they often take a notion to grow dull. When there is a grinding wheel about the premises there is mighty little excuse for them staying dull, at

least. Open up one blade as wide as it will go. Lay the other blade across the wheel, tilting it sufficiently to meet the old angle. Then pull the blade back and forth across the rim of the wheel, being careful to preserve the same angle throughout—an angle equal to one-third of the square of the blade's thickness. (See *Fig. 14.*)

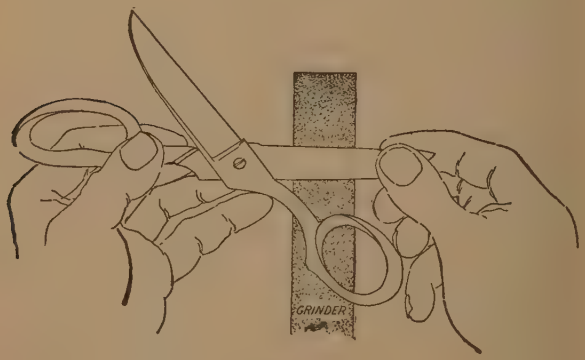


Fig. 14. Grinding Dull Scissors.

Sharpen the other blade in the same manner. Then rub a slipstone over the ground portion, also lightly and flatly along the side of the blades, to wear off all particles of wire edge.

If a scissors point gets broken off, lay the other point across the sharp edge of the wheel and grind it half through, doing likewise from the opposite side. A light tap with a hammer will break off the point, whereupon you can reshape both blunt ends into the kind of points milady-of-the-house wants.

Tinner's Snips are only a heavy edition of the household shears. When dull, they should be ground in the same manner as shears or scissors, and honed, although in the latter process you do not have to be quite so painstaking.

A Hatchet is a rough-cutting tool, and therefore needs no honing. Remove any nicks it may have by holding its cutting-edge squarely against the rim of the grinding wheel. Rebevel in the usual manner.

An Axe (*Fig. 10*), whether it is a Boy Scout hand-axe, or a single-bitted or double-bitted woodsman's axe, is handled in much the same way as a hatchet. However, there is this distinction: The axe has a rounded cutting-edge; to preserve this, give the implement a slight swinging movement as you pass its edge back and forth across the edge of the grinder. Do not hone an axe. It is ready to use as soon as it is properly ground.

A Lawn-mower that fails to cut the grass properly may either have dull knives or have its shearing plate out of correct adjustment. Sometimes a machine of this kind has both faults. Before sharpening the knives, inspect the shearing plate. It should come so close to the knives, as they revolve, that they will just clear it. Make the correct adjustment, if required, by tightening or loosening the proper bolts or setscrews. Often grass cuttings get plastered along the plate. These should be removed, of course, as they retard the cutting of the mower.

Most lawn-mower knives are hard to get out; therefore, it is not convenient to sharpen them on a grinding wheel. Use a medium-sized mill file, and turn the mower upside down, so that you can get at each blade

or knife. The sharpening is not as tedious as you might fancy; lawn-mower knives are usually made of quite soft steel, and being thin, the file soon conquers them. The bevel is very slight—about like that of a pair of shears. (See *Fig. 15.*)

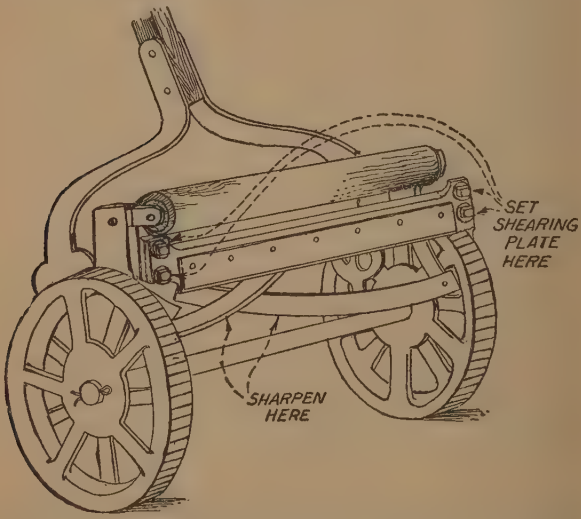


Fig. 15. Tip Over the Lawn-mower and Sharpen the Knives with a File.

An Auger Bit cannot be ground; it must be sharpened by hand with a special tool called a bit file. (See *Fig. 7.*) Lay the dull bit on the bench, and file the *inside* of the lips, and the *upper* sides of both cutters, supporting the bit at an angle with one hand. Never attempt to sharpen the worm, as you will only make it worse.

A Drill is a metal-working tool, and, as such, it is likely soon to become more or less dull. Some drills are soft enough to resharpen by filing with a mill file, but most of them must be ground. Give them a slight rolling motion, which will bring the lips at the proper slant to make them cut. The bevel for a drill for ordinary metal boring is 30 degrees. For wood boring it is 60 degrees. For reaming it should be 5 degrees.

III

LUMBER

In order to carry on the wood repairs which arise about the home, it is quite important that you understand something about the source of the boards you use, how they are cut out of the log, how they are graded by lumber dealers, how seasoned, how measured, and other facts that affect your interests.

The Names of the Parts of a Log, as it lies ready to be sawed up into lumber, are given in *Fig. 16*. It is

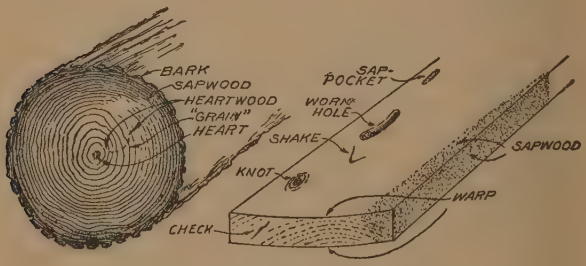


Fig. 16. The Parts of a Log.
Fig 17. The Defective Parts of a Board.

well to learn these, as the knowledge will help you in eventually handling the boards themselves.

The narrow rings represent the winter period of the tree's growth, one ring forming every year. The lighter colored wood between the rings represents the summer's growth of the tree. This summer wood is softer than the annular rings, which are of a resinous composition. The wood in the center of the tree is

dark-colored and is known as heart wood; but in the vicinity of the bark, it becomes considerably softer and comparatively white. This light-colored portion is termed sap wood. Through its loosely-knit fibers most of the tree's sap makes its way to twig and leaf. Sap wood produces an inferior grade of lumber, therefore sells for less than the more solid darker wood.

Common Defects of Lumber are shown in *Fig. 17*. For some purposes, such defects injure the strength of a board; in other cases, they do not. They are always unsightly, if they come in a position in the construction so that they are seen, although this ill appearance can be almost if not entirely eliminated by applying certain filling agents which are described in Chapter XII. All lumber is graded by lumbermen according to such defects, and if stock is sold to you unusually cheap it is wise to inspect it before buying.

Two methods of sawing are used in getting lumber out of a log. These methods are termed plain-sawing and quarter-sawing.

Plain-sawing (*Fig. 18*) is the method adopted for cutting up building lumber. A slice, or slab, is taken off each side of the log, leaving the core square and barkless. This square timber is then run through the saw, back and forth, and the piece cut up into as many boards of the desired thickness as it will produce. There is a minimum of waste in cutting in this manner, and it accordingly renders the cheaper lumber of the two methods cited, but, on the other hand, the boards are much more liable to warp than if quarter-sawed.

Quarter-sawing (*Fig. 19*) is the method used for getting out furniture lumber and musical instrument

stock. The log is first halved, then the halves are halved. The boards are alternately cut from each flat side, until only a small and worthless piece is left. The waste is considerable, and the price of such lumber is consequently high, but it is the best way to get out walnut, mahogany, white oak, and other fine cabinet woods.

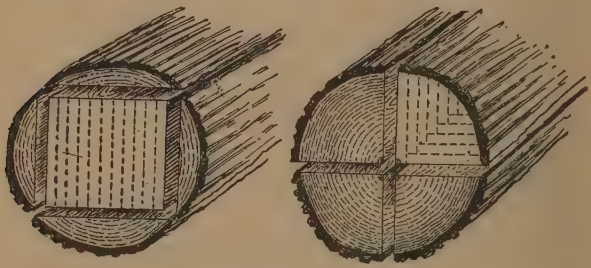


Fig. 18. The Method of Plain-sawing Lumber.
Fig. 19. The Common Method of Quarter-sawing Lumber.

Kiln-drying is the process used by planing mills and furniture factories for quickly driving out of the lumber all excessive moisture. The green lumber would shrink if made up into cabinetwork, causing both weakness and ill-fitting joints. So it is put in a building called a dry-kiln; the kiln is closed up tightly, and steam is turned on to open up the pores in the lumber and to allow hot, dry air to penetrate. In a few days' time the lumber is quite thoroughly dried out and ready to be sold and used by the consumer. Building lumber should not contain more than 8 per cent. of moisture, and furniture lumber not more than 5 per cent.

Veneer (*A, Fig. 20*) is very thin wood, averaging 1/20 of an inch, which has been sliced, like the peeling of an apple, from log bolts. It is seldom used in building operations, but is often applied to furniture construction, its chief use being devoted to gluing it over the visible portions of cheaper and plainer stock, in order to beautify them, for veneer is only cut from

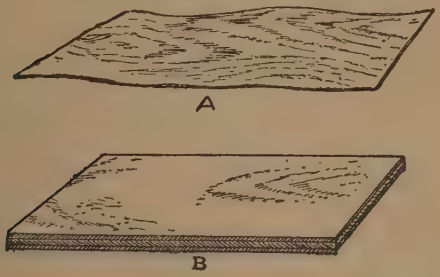


Fig. 20. *A*—Veneer Sheet. *B*—Veneer Panel.

the choicest and best-figured logs that belong to the furniture category.

Veneer Panels (*B, Fig. 20*) are panels made up of several layers of veneer, glued with the grain crossing, which gives them great strength. Such panels can be had in various cabinet-woods, and find many uses about the home. Common thicknesses are 3/16, 1/4, 5/16 and 3/8 inches, and these are always composed of an odd number of segments, usually either three or five.

Lumber Grades used to be very uncertain, and caused a great deal of dissatisfaction to buyers, because there was no definite manner of grading stock

in general, every mill owner or lumber dealer using his own judgment as to defects. But to-day most of these sellers are associated in a common business organization, and at one of their meetings not long ago decided upon a standard method of lumber grading. This rule-book can be obtained free of cost by applying to your local lumber dealer.

The associated dealers define lumber as follows:

Firsts Seconds	Sold as one grade; marked FAS.
Select and No. 1 Common	Sold as No. 1 Common and Select.
No. 2 Common	
No. 3 Common	

Lumber Sizes come in various thicknesses, widths and lengths. The most common thickness for rough lumber is 1 inch; for planed lumber, 13/16 inch. The common width is 5 inches. Lengths usually run to 12 feet, 14 feet and 16 feet.

Lumber Surfaces are either "rough" or "surfaced." It requires a loss of close to 3/16 inch to mill-plane a board on both sides. If you want your stock planed at the mill, so specify it, and be careful to state just how many surfaces you want planed. For instance, if you mark an item "S2S," it signifies that you wish the dealer to "surface 2 sides," and he will do your bidding at an average additional cost of 1 cent per lineal foot. If you mark "S4S," he will not only plane both sides but also both edges of the boards you order.

The Common Kinds of Lumber Used in Building Operations at the present time are: White pine, western pine, yellow pine, Norway pine, Douglas fir, redwood, cypress, and basswood. Inside trimmings are made from white oak, red oak, gumwood, and sometimes from mahogany and walnut. Floors are made of both soft woods and hard woods, oak and maple being generally adopted where hardwood is wanted.

Lumber Measurement is based upon the board-foot. A board-foot is a block 1 inch thick, 12 inches wide, and 12 inches long. Thicknesses under 1 inch count as 1 inch. Thickness of 1¼ inches or over are so measured.

The following example will make the subject plain:

How many board-feet are there in a piece of lumber 12 feet long, 7 inches wide, and ¾ inch thick?

Solution. Multiply the length in feet by the width in inches by the thickness in inches. Divide the result by 12.

$$\frac{12 \times 7 \times 1}{12} = 7 \text{ b. f.}$$

To Make Out a Lumber Order, first prepare an itemized list of the various parts of your construction, allowing about 10 per cent. for waste. Arrange together the parts which have similar thicknesses and widths, and figure as many of them as possible into a standard sized board length. Thereupon hand the lumber dealer a list containing only the boards you will need.

Lumber Quotations are usually based upon 1,000 board-feet. Thus, if a dealer gives you a price of $80.00 on a certain kind of lumber, you can quickly determine the price per single board-foot by the process of decimal reduction. Pointing off, therefore, three places, we find that 1 board-foot of this lumber will cost us 8 cents.

IV

SQUARING METHODS

As a general thing, every piece of board, or board itself, has six surfaces. These occur in pairs, each one of a kind being opposite its mate.

The Names of the Parts of a Board are shown in *Fig. 21*. These are sides, edges, and ends.

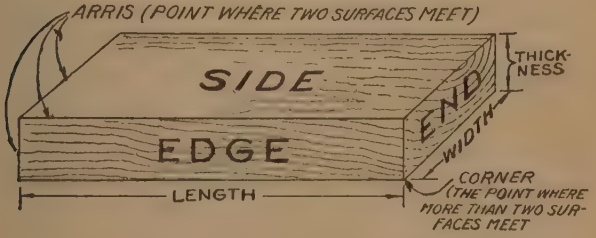


Fig. 21. The Parts of a Block or Board.

The sharp portions of the board, where any two of these six surfaces meet, are termed arres, and one sharp portion alone is called an arris. Length arres are those running with the grain of the stock; width arres are those running across the grain; thickness arres run from side to side.

The sides of a board are always its broadest surfaces along which the grain travels. The edges are the narrowest surfaces along which the grain travels. The ends are the narrow surfaces where the grain crops out or terminates.

As they come from the mill or lumber dealer, the six surfaces are usually more or less rough, and it becomes the job of the home mechanic to make them as perfect as his skill and his tools will allow.

Laying Out Stock in the Rough is your first operation, if you have two or more pieces to get out of a single board. This procedure is started by laying the board on the bench or sawhorses and marking out the pieces with sufficient allowance over the finished sizes to permit of tool operations in truing up the stock. This allowance is not arbitrary, depending upon the condition of the lumber, but if there is enough extra stock it is a safe thing to add 1 inch for length, ¼ inch for width, and ⅛ inch for thickness.

Use a heavy, soft pencil, well sharpened, in laying out these rough sizes. A carpenter's pencil, so called, makes an excellent marker, as it is made especially for such work. Such a pencil is shown, along with other laying-out tools, in *Fig. 22*.

Before laying out your pieces, inspect the portion of the board you want, to see if, on either side, it contains defects which would make it worthless for your purpose. Then begin with the laying out by first marking the rough length of one of your pieces. Through this point square a pencil line across the board. Mark on this line, also on the end of the board, the width of stock you want, and connect the points by a pencil line which you can make by gauging or by using a straight-edge.

Getting Out Stock in the Rough embraces the operation of removing the smaller piece from the larger. It is done by first ripping from the end of the

board to the cross-line, then cutting along the cross-line until the block falls out.

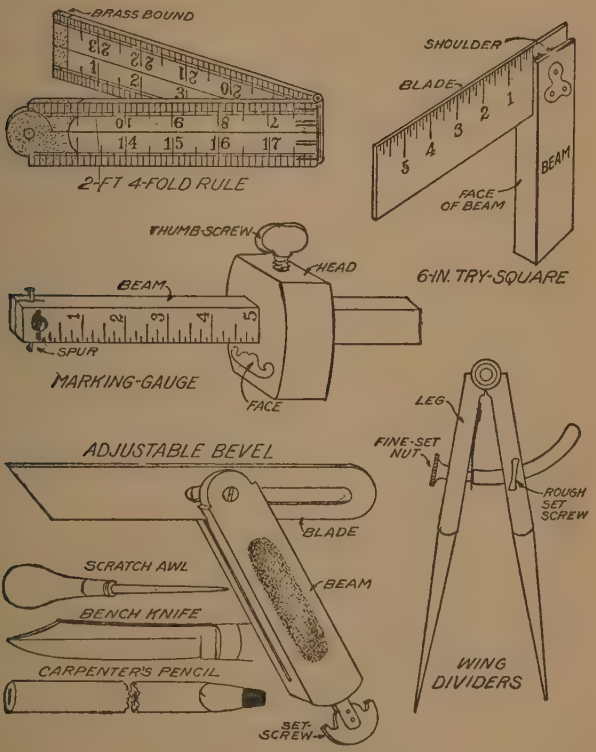


Fig. 22. Laying-out Tools.

The rough surfaces on your block must now be trued up by a systematic process.

The Squaring Method is accomplished as follows:

1. Produce a face side.
2. Produce a face edge.
3. Produce a second edge (width).
4. Produce a first end.
5. Produce a second end (length).
6. Produce a second side (thickness).

It will be seen that similar surfaces follow each other in treatment, except in the case of the sides; there we secure one side at the first operation, and do not secure the second side until the last operation.

It will also be observed that, of the three dimensions sought, width is always the first one obtained; length, the second one; and thickness, the third and last one.

All of the operations can be performed by a skilled workman in about seven minutes, so a little practice on your part ought to put you in the ten-minute class, at least.

An explanation of the terms "face side" and "face edge" may be desirable. The face side of a board is that side which has been dressed with the idea of eventually using it as the top side when the piece is assembled in a cabinet or otherwise put to service. In other words, the face side of a piece of wood is that side which is destined to face the onlooker. Similarly, the face edge of a board is that edge which will be placed outward, if there is any choice in the matter.

Taking it for granted that you have had the forethought to mark out your desired piece a little larger than the finished dimensions, and that you have removed it from the parent board by first ripping, and then by cross-cutting, the step to take before using a

plane is to note if the piece is warped. Usually this can be done quickly with the eye, by holding the stock in line with your vision and sighting across it. If the warpage is too slight to be visible in this manner, it probably can be detected by laying a framing-square or straight-edge across the side. But if there is a twist or wind to the board, which sometimes occurs in lumber that has been forced through the kilns too fast, the best way to test the surface is to use a pair of sighting-sticks. (See *Fig. 23.*)

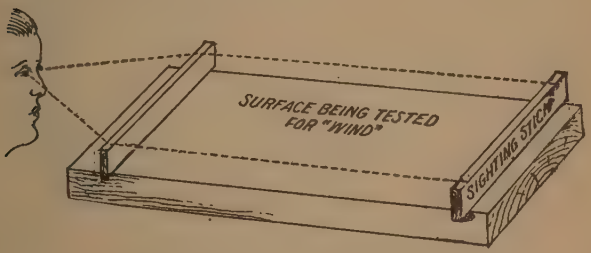


Fig. 23. Testing for "Wind" in a Board.

Sighting-Sticks can be utilized from a pair of yardsticks. Sight over them; if one end rises over the opposite stick, that portion of the board should be planed down. When you have dressed the surface so that there is no longer any wind in it, the edges of the sticks will accord. Thereupon place your framing-square or try-square first lengthwise and then breadthwise of the surface, and see if it is level both ways. (See *Fig. 24.*) Use the eye in testing for smoothness. If everything is all right, place a short pencil mark upon the face side, so that you can distinguish it after the second side has had its own dressing.

The face edge is obtained by dressing down the best edge of the stock to where the edge is not only smooth but level, and to where it is also square with the face side. Test for levelness by placing the edge of the square blade lengthwise upon the surface. Test for squareness by placing the handle or beam of the square against the face side, with the blade across the edge. Check-mark the face edge as soon as it proves correct.

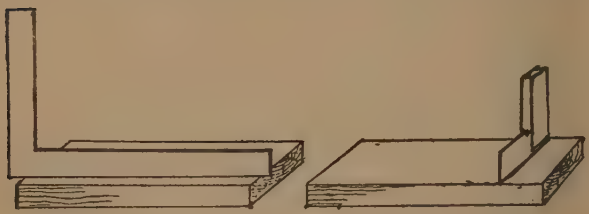


Fig. 24. Testing for Levelness of a Board's Side.

To secure the second edge or width, set the marking-gauge to the desired size. In doing this, hold the pin end up, and crowd the thumb upward under the head until the dimension has been reached; then verify the setting by superimposing a rule, as at *A* of *Fig. 25*. If the gauge head seems too far advanced, loosen the setscrew, contract the thumb and it will follow by force of gravity to the desired point. Then reset the screw and again test with the rule.

In Gauging Narrow Stock (*B, Fig. 25*), the hand supports the gauge at the head, enclosing it in the palm; but for wide gauging—say, 5 or 6 inches—you must grip the beam itself, very close to the pin, in order to accomplish good results. (See *C, Fig. 25*.)

The point is, always hold the gauge as near the pin as possible.

Another important feature in using a gauge is to push it away from the body, also to give it a tilt so

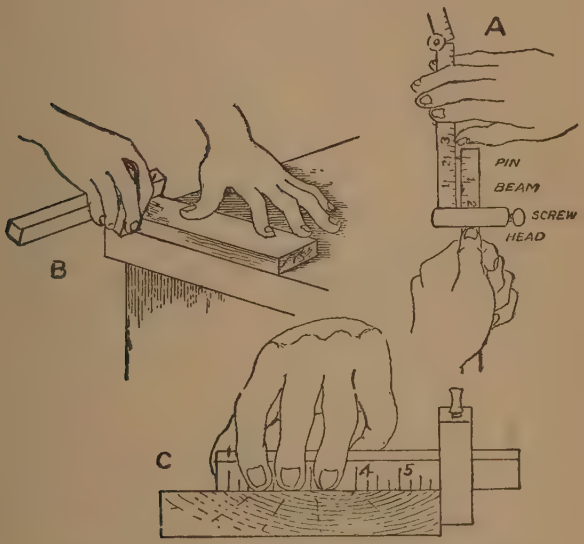


Fig. 25. Setting and Using a Marking-Gauge.

that the pin will drag. A light, steady pressure upon the pin, a constant light crowding of the gauge head against the edge of the board, will invariably produce satisfactory results.

But care must be taken to see that there is no likelihood of the tool striking the holding hand. Beginners prevent this best by holding the piece over the edge of the bench, as at *B, Fig. 25,* but veteran workmen

find they can make greater speed by supporting the wood freely in the left hand, first at the far end, then, as the gauge goes forward, at the near end, stopping the operation a moment to make the change.

If your desired width is greater than your gauge will reach, it will be necessary to measure off the distance at each end of the stock and to connect the points with a pencil line made along a straight-edge.

The removal of the surplus wood may be done in several ways, the best way depending upon conditions. As a rule, if the surplus is more than 1 inch wide, it ought to be ripped off quite close to the line, leaving just enough wood to permit of finishing with a smoothing plane, or with a jack plane used in lieu of a smoother. If the surplus is under 1 inch, it should be planed off.

Test the levelness of the second edge with a square laid lengthwise of it, beam in the air. Test for squareness by placing the beam of the square hard against the face side, with the blade edge across the new edge. Test for smoothness with the eye, as in the other case. Test for correctness of distance from the face-edge by measuring from the latter, at both ends. Give the surface a distinguishing mark.

In cutting off the first end, always first choose the best end; that is, choose the end which is most perfect both in quality and in squareness. It may be so square that you will not have to saw it—merely have to do a little planing or other dressing-tool work. If, however, you think you can expedite matters by sawing, square lines for that process. If possible, make such lines not less than ¼ inch from the end. For rough work, such

as packing-box construction, two lines will suffice, made with a pencil, one line across the face side, and the other across the edge that will face you when you are ready to saw. For finer construction work, where squareness is an important consideration, make lines all around the stock, using a sharp pencil on hard wood and a sharp knife on soft wood.

These lines, if squarely laid out, will meet each other. They are made as follows: Having located the position

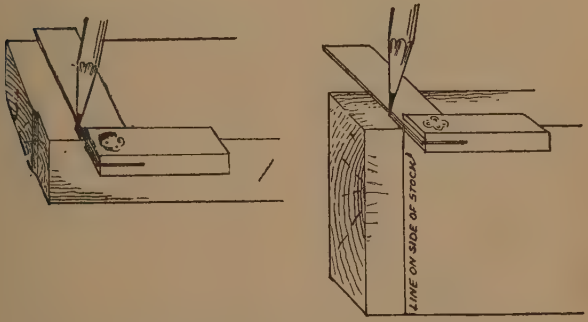


Fig. 26. Squaring a Line Across the Face Side from the Face Edge.
Fig. 27. Squaring a Line Across the Second Edge from the Face Side.

for the cut, place the beam of the square against the face edge and make a mark across the face side. (See *Fig. 26.*) Carry this line over the second edge, by placing the beam of the square against the face side. (See *Fig. 27.*) Set the board on the second edge, and carry the line across the second side, being sure that the beam is against the face edge while so doing. To

put the process in a nutshell, square lines around the stock, with the beam *always* in contact with a *marked* surface.

The sawing should be done *against* the line, on the *waste* side; in other words, you should see the entire line, and nothing more, upon the piece you want, when you have finished. To leave less is to make your wood too short; to leave more is to waste your time and effort in subsequent tool operations directed toward removal of the surplus.

What saw will you use? That depends, again, upon conditions. If the stock is 4 inches or more wide, use a cross-cut hand saw. If it is less than 4 inches, use a back saw, if you have it. With the hand saw, hold the piece on the horses, under your knee, if it is long; if short, place it in the vise. With the back saw, hold it in on the bench hook, with the bench hook upon the bench top.

Further directions on sawing will be found in the following chapter.

When the end is sawed off, it will be found to be somewhat scratched. Remove the roughness, in fine work, by using a finely-set plane for stock 2 inches wide and over; for narrower stock, use a sharp spoke-shave, likewise finely set. Test the end for squareness with the face edge by placing the try-square beam against the face edge; then test for squareness with the face side by placing the square beam against that side.

To obtain the length, place the desired figure of the rule against the squared end, and with a knife prick a point at the end of the rule. Through this point square lines for another sawing job. After saw-

ing, dress down the roughness as with the first end. Then test for squareness; and, this time, also test the length by applying the rule.

The thickness, as previously stated, is the last operation in squaring up your piece of wood. You have now reached this point. Begin operations by setting your marking-gauge to the desired thickness. With the head of the gauge against the face side at all times, run lines around the entire block, scribing both edges and both ends.

If there is ⅛ inch or more of wood to remove, rough off most of this with your jack plane, set fairly deep, finishing to the line with a smoothing plane. If you have but one plane, set the cutter to meet the conditions named. Test this side for levelness as you did with the face side. Test the thickness by applying your rule at several different points along the border.

Duplicate Pieces of Stock, if small, can be obtained to better advantage if the foregoing general squaring-up procedure is somewhat modified. Suppose, for example, that you wish to make something requiring two pieces of wood, each piece of the same size—say, 4″ x 2″ x ½″.

You will facilitate operations by proceeding as follows:

(*a*) Multiply the length of one piece by the number of pieces desired; then add a reasonable wastage—say, 2 inches—for cutting off ends.

(*b*) Get the stock out in its rough sizes, allowing ¼ inch additional to the finished size for the width, and 1/16 inch additional for the thickness.

1. Produce a face side.
2. Produce a face edge.
3. Produce a second edge (width).
4. Produce a second side (thickness).
5. Produce a first end.
6. Produce a second end (length of first piece).
7. Produce a first end (of second piece).
8. Produce a second end (length of second piece).

V

EDGED TOOL PROCESSES

Edged tools embrace that variety of tools which have a sharp edge that is designed to remove wood and create a desired form in the piece being worked upon.

The Jack-knife and Bench-knife are probably the two most simple and most popular types of edged tools used by man. The only marked difference in them is that the jack-knife has folding blades, while the bench-knife has a fixed blade. For use at the bench, the latter has the advantage, as its fixed position renders it more rigid and safer to use. A good bench-knife, too, is less expensive than a good jack-knife. Fifty cents will usually get a first-class bench-knife; twice that sum must be paid for a jack-knife of equal quality.

Every now and then you will run on to some printed advice—which is probably written by a dry-goods clerk or a druggist—telling you never to whittle toward yourself. Such statements always make a mechanic laugh, for he knows very well that fully 25 per cent. of the excellent whittling done in the world is done "toward you." The fact is, there are numerous occasions when you cannot whittle to good advantage without cutting toward some part of your person. Cut guardedly and you will seldom get a wound.

If You Get Cut, do not get flustered about it. Immediately place your thumb over the gash and press hard enough to keep the edges of the flesh together and

the blood from oozing out. Then seek some one who will bandage up the wound for you. If the tool that cut you has previously been used in cutting clean wood, there will be no need of cauterizing or sterilizing the cut. But if the blade is dirty or rusty, great danger is incurred if you do not take measures to prevent infection. Apply carbolated salve, iodine, or some other good disinfectant.

To Cut Off the End of a Thick Board with a knife might seem an impossibility, but such an operation is not very difficult, even with a board 1 inch thick and 6 inches wide—if you know how to do it.

Fig. 28 shows the steps in performing this operation. First square lines around the stock at the point where

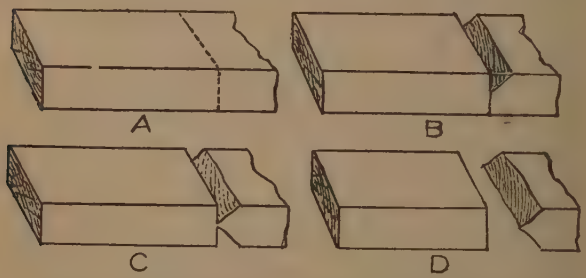
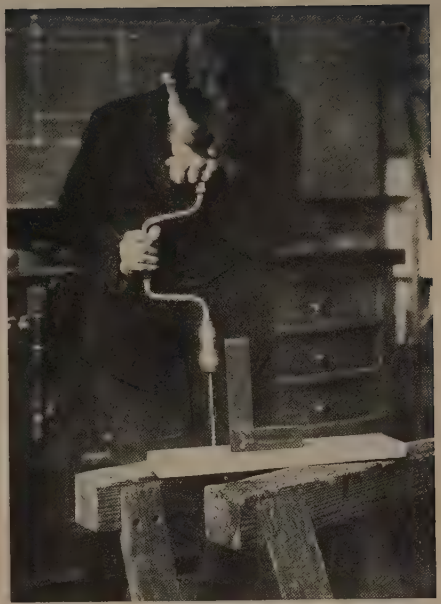


Fig. 28. How to Cut Off the End of a Board with a Knife.

it is to be severed, as at *A*. Gripping the knife in the fist, scribe the face-side line quite deeply by making several cuts, one on the other. Tilt the knife and make a V-cut on the waste side of the cutting-off line, as at *B*. Keeping the blade upright, scribe deeper along the square shoulder. Then tilt the blade again, widening and deepening the notch, repeating these opera-

PARING WITH A CHISEL



BORING ON THE SAWHORSES AND USING A TRY-SQUARE TO INSURE PLUMBNESS

tions alternately until you are about half-way through the board. Next, turn the wood over, and repeat the process of cutting from the other side (see *C*) until the board is completely and neatly severed, as at *D*.

To Whittle a Concavity in the edge of a piece of stock, first lay out the shape of the hollow-to-be, as at *A, Fig. 29*. Then, angling down from both sides, cut out a notch to the bottom of the concavity. (See *B*.)

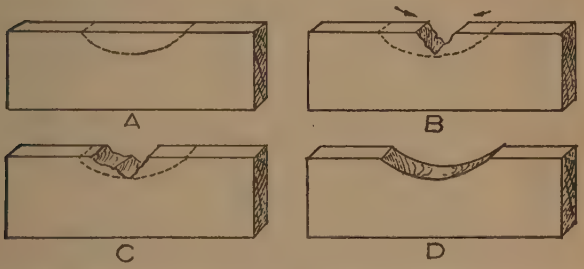


Fig. 29. How to Use a Knife in Cutting a Hollow in the Edge of a Block.

Thereupon, the notch is enlarged at its widest portion (see *C*), until its walls recede and become blended into the penciled lay-out, which will finish the cutting, as at *D*.

Saws quite naturally become the second most useful edged tool about the home shop. There is a wide variety of these toothed cutting devices manufactured for different purposes, but you will be interested only in the few that are called into use about the household. These are the rip saw, the cross-cut saw, the back saw, and the compass saw.

The Cross-cut Saw and Rip Saw belong to the family known as hand saws. In a general way, they

are much alike, the handles and blades being of the same sort and the teeth all set. Upon close inspection of *Fig. 30*, you will note that the teeth in the cross-cut

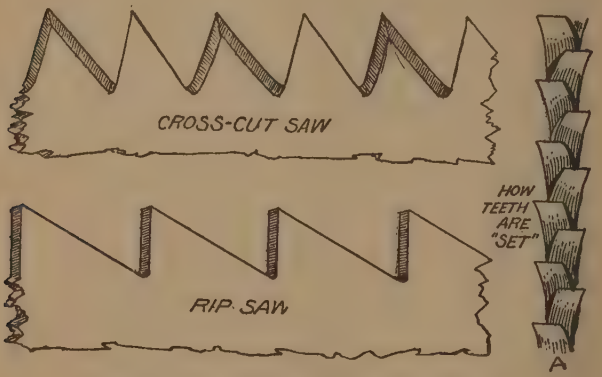


Fig. 30. Close-up Views of the Hand Saws.

saw are of a V-shape and that they are beveled alternately on a certain side. On the other hand, the teeth of the rip saw are not beveled; moreover, the forward side of the tooth is almost perpendicular, while the other side is a long bevel. Hand saws are sold by the "point" system, a 7-point saw having seven teeth points to every inch of its length. The higher the number of points, the finer cut the saw will make.

The teeth are said to have a "set" when they are bent alternately outward, as shown at *A* of *Fig. 30*. Except for this feature, the back of the saw would pinch in going through a board of any considerable width or thickness.

It is not advisable for you to attempt to sharpen or reset a hand saw, as it takes a skilled saw-filer to do a

job of that kind in the right way. If your saw gets dull or out of order, your local hardware dealer will tell you where to go to have it reconditioned.

It never pays to buy anything but the best hand saws, those that have a reputation, that have a good "hang" to them, and that likewise possess well-tempered steel. A good one, with proper care, will last a lifetime. Be careful not to kink or bend the saws; and do not saw into nails or other metal objects if you expect the teeth to stay sharp.

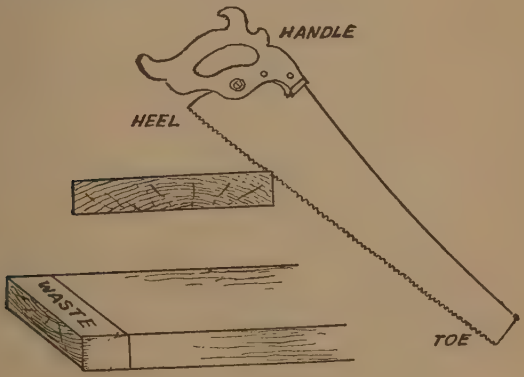


Fig. 31 A. Starting the Cross-cut Saw.

If you can afford only one saw, get a cross-cut. You *can* manage to rip with a cross-cut saw, but you *cannot* cross-cut with a rip saw. Buy the two saws, however, if you can afford it. Remember that a rip saw is strictly intended to be used when cutting in the direction of the run of the grain, and that a cross-cut saw is to be used for cutting across the run of the grain, either straight across or diagonally.

In starting either kind of saw, you should place the rear portion or heel of the blade upon the farthest arris of the board, as in *Figs. 31 A* and *31 B*, and draw the saw toward you under a firm pressure. If it jumps

Fig. 31 B. Position to Take When Using Cross-cut Saw on the Sawhorses.

or sticks when you make the first pushing stroke, withdraw it from the kerf or cut and reset it in the first position, again drawing it toward you.

Acquire the habit of always sawing on the *waste* side of the mark, just leaving the mark and nothing more. Watch every stroke like an eagle. The instant

you note the saw diverging, twist the handle gently until you are back again.

In finishing a cut across a wide board, find some means—either your unoccupied hand or a sawhorse—of supporting the end being cut off, otherwise its weight will cause it to splinter when the cutting is nearly finished. Sawing with a very light pressure, and using short strokes, will also help to prevent, at the finish, wasting valuable stock from the cause named.

The Use of a Back Saw will not be required for rough sawing, such as general carpentry, but it is well to have a back saw in the home shop in case you may sometime wish to repair furniture or do a little cabinet-making yourself. This saw has a ribbed back which makes it very stiff, and since it has finer teeth than the hand saws, it is possible to do a very nice class of sawing with it, such as the making of joints.

When using this saw, the work is either held in the vise or in a benchhook, and the cut can be made either with or across the grain. Do not try to cut off a 6-inch board, however; that kind of a board belongs to a larger type of saw, such as a cross-cut.

Cutting With a Compass-saw is not as difficult as you might think. These narrow blades will easily saw out various forms of curved outlines, but their chief purpose is that of cutting out holes—square or round—which may occur in the interior of a board. To do a job of the latter kind, all you have to do is to bore a hole, to admit the saw blade, through the stock adjacent to the outline to be followed, then follow the outline while at the same time keeping your saw parallel with the bench top.

The Structure of a Bench Plane is clearly shown in *Fig. 32,* and in *Fig. 33* some of the principal parts

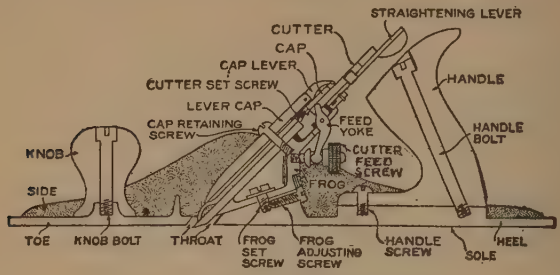


Fig. 32. Structure of a Bench Plane.

are shown in enlarged form. To use a plane skilfully it is quite essential to keep it in perfect working order, and to keep it in perfect working order it is just as

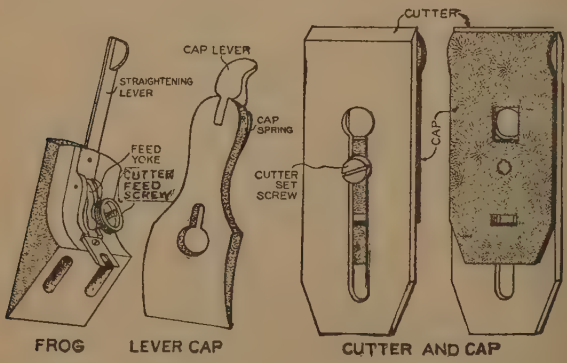


Fig. 33. Perspective Views of Principal Parts of a Plane.

essential to understand the working principle of its parts; for there is no hand tool more easily put out of

adjustment than a plane. If you have not already done so, take your plane apart this very day, studying its mechanical arrangement and action as you remove part by part.

Some important features to remember are the following:

1. The setscrews on the frog regulate the opening of the throat. If your plane chokes with shavings, it shows that you must either set back the cutter for a lighter cut or enlarge the throat.

2. The cutter feed-screw advances and recedes the cutter. Turning the screw to the right advances the cutter for a deeper cut and a heavier shaving. Turning the screw to the left recedes the cutter for a shallower cut and a lighter shaving.

3. The straightening-lever is for the purpose of aligning the cutting edge of the cutter with the sole or bottom of the plane. If you find your cutter making a shallow furrow at one side of the plane's passage, it is likely that the cutter is not setting squarely. Operate the straightening-lever to remedy this trouble.

4. The cap retaining-screw regulates the pressure, though indirectly, and keeps the cutter locked in the position at which you set it by means of the feed-screw and straightening-lever. If your cutter will not stay in position—if it moves while you are planing—it is a sign that the cap retaining-screw is too loose. Therefore, tighten it a little, until the cap-lever exerts sufficient pressure upon the spring below it to bind the cap securely against the cutter.

Never begin planing without:

1. Feeling of, or looking at, the cutter's edge. It

may be so far out that the first stroke will ruin your wood.

2. Inspecting the surface you are about to plane. It may contain broken-off nails. It may be so warped that, in order to save it, you cannot afford to plane off a single shaving where the low spots occur.

3. Studying the run of grain. If you plane in the wrong direction, the first stroke may spoil your piece.

I have already told you how to judge and correctly set your cutter; have likewise advised you how to detect warp and wind, low spots and high spots, in a board surface. But I have not told you how to avoid planing in the wrong direction.

If you will consult *Fig. 34* you will note two pieces

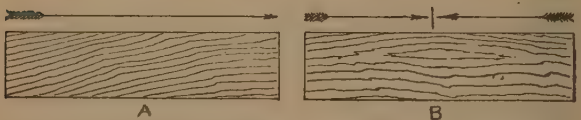


Fig. 34. Correct Directions for Planing Boards of Varying Grain Runs.

of board each of which contains a different formation of grain. If you were to dress down the upper edge of *A*, at which end would you start—the left or the right? The left end is the correct one. If you cannot grasp the reason why, imagine the outcropping grain ends to be hair on a boy's head instead of woody fibres. To smooth down such hair with a brush or comb, I am quite sure you would carry your stroke from left to right rather than from right to left.

Perhaps the foregoing object lesson is enough on this subject, yet I am tempted to give you one more,

which exemplifies a variation very often encountered by good workmen. For this inspect *B*, of *Fig. 34*. Here we have grain outcropping from two opposite directions, forming a sort of "hill" near the center. Manifestly, we must plane in two directions, beginning our stroke in each instance at the end of the board and finishing it at the crown of the "hill."

In the same manner, the grain of a board's side should always be studied before using a plane upon it, and to make sure your decision is not in error, the first

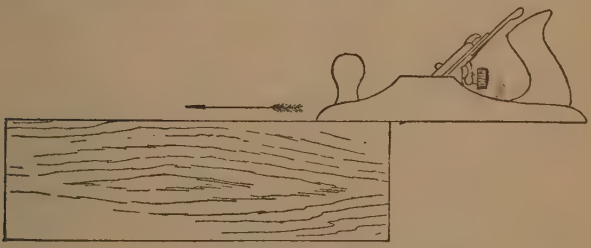


Fig. 35. Starting the Plane on an Edge.

stroke should always be a cautious one, and you should be unusually observant of the degree of *smoothness* that results.

Sometimes beautiful wood is of involved grain, so that it must at times be planed against the grain. An expert carpenter soon learns how to use his plane in either direction, but a beginner or amateur will play safe if he studies the grain. Where the lumber is dirty or weather-stained no better clue can be asked than the roughness caused by mill-planing, for the deepest ends of these marks point to the end of the wood where you should begin planing. If there are

no mill marks to guide you, take a cautious stroke, then study the surface for tears which will show you where to start the next stroke.

In Starting a Plane on Level Wood *(Fig. 35)*, have the cutter just beyond the stock, with the plane flat upon the surface to be dressed. Grasp the handle and knob firmly and push the plane forward under considerable pressure from the arms and shoulders. Do not pause in your stroke unless the board is so long that you must move along with the plane. In that case,

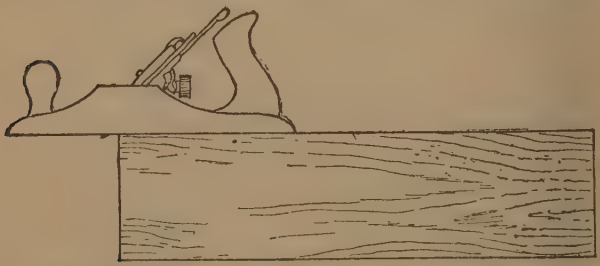


Fig. 36. Finishing the Plane Stroke on an Edge.

stand still and push the plane as far as you conveniently can; then, without raising it from its last position, step forward quickly, and carry the plane on for another stroke, repeating to the farther end of the piece. If this is done correctly, you can take off an unbroken shaving whose length will correspond with the length of the board, no matter how long it may be. I have often seen beautiful, crisp pine shavings sixteen feet long which were removed by hand-planing in the manner described.

When Finishing a Stroke With a Plane (*Fig. 36*), the greatest care is required to keep the tool from drop-

ping in front and tilting up behind—in a sort of diving act. Such an ending can only prove disastrous to a level surface, as it causes the cutter to cut off more wood at the extreme end than it does elsewhere. To prevent this, bear down hard on the heel end of the plane and stop the stroke just as soon as the cutter has passed into space at the far end.

The Return of the Plane (*Fig. 37*) is also important. Lifting it entirely off the surface wastes strength;

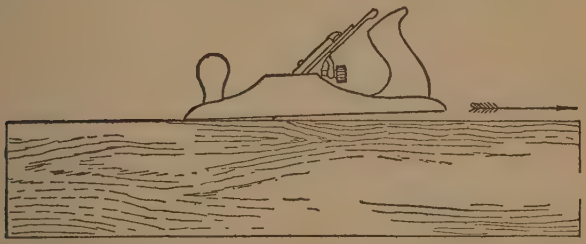


Fig. 37. Returning the Plane for Another Stroke on the Edge.

dragging it, flat, back along the course causes a friction on the cutter that certainly does not make it any keener nor the surface any smoother. The right way to return the plane for another stroke is to tilt the heel end enough to bring the cutter off the wood, then to drag the toe end lightly back over the surface.

On a wide surface that is already level and only needs a little smoothing, the first stroke of the plane should be along the extreme edge; the next stroke should barely lap it, and the next stroke should likewise barely lap the second one; and so on until the whole surface has been planed uniformly—dressed no more in one place than in another.

Very often, after gauging the width of a piece of stock, you will notice that there is more surplus wood to remove at one end than at the other. Such a situation as this troubles the inexperienced planer more, perhaps, than any other, but it ought not to bother you after studying sections *A* and *B*, of *Fig. 38*.

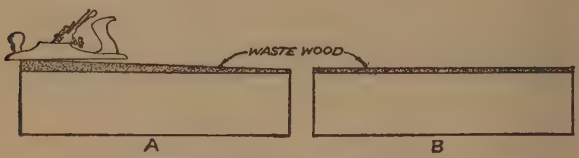


Fig. 38. Planing Down Uneven Wood to a Line.

The illustration at *A* shows that the plane should first be set to work upon the highest elevation, gradually reducing this as the tool works back into longer and longer strokes. By the time it has reached the opposite or low end, the former high end should have been brought down to a point that renders the surplus wood throughout the board's length approximately uniform, as at *B*. Then it is only a matter of long, even strokes, from end to end, to reduce the remaining waste wood to the line.

There are occasions when it becomes necessary to deal with stock of a very burly or knotty nature. Inasmuch as the grain in such wood runs helter-skelter, taking almost every direction, it is a difficult problem for the beginner in wood-working to understand how he can ever acquire a smooth surface with his plane. But it can be done. The solution is, instead of planing from end to end, you should guide the tool either

straight across or diagonally across the surface, having the cutter set very fine. (See *Fig. 39.*)

Planing Ends of Boards is another trouble-maker for the amateur wood-worker. As a rule, a saw does

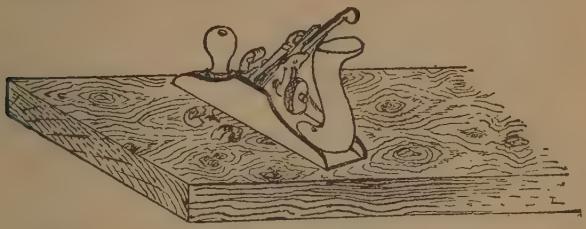


Fig. 39. Facing Up a Knotty Board by Cross-Planing.

not leave an end sufficiently smooth and square for joinery purposes, and some shaving tool must be used to produce the required refinements. For ends wider than 2 inches, a plane is usually employed; for ends 2 inches or less, a spokeshave will prove better.

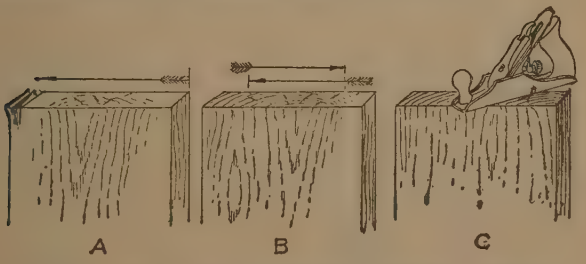


Fig. 40. How to Plane End Wood, With and Without Splitting It.

If you plane clear across an end, the far corner will always break, as at *A* of *Fig. 40.* To prevent this, do not allow the plane cutter to reach quite as far as the

opposite end; then turn about and plane toward the first end. (See *B.*) In doing this kind of planing, rest the plane somewhat diagonally across the end, as at *C,* so that you will obtain what is termed a shearing cut, which is the best manner to plane all end wood.

To Round a Stick with a plane, which is usually the best tool to use for that job, first make the stick square (see *A, Fig. 41*) and of the same diameter as

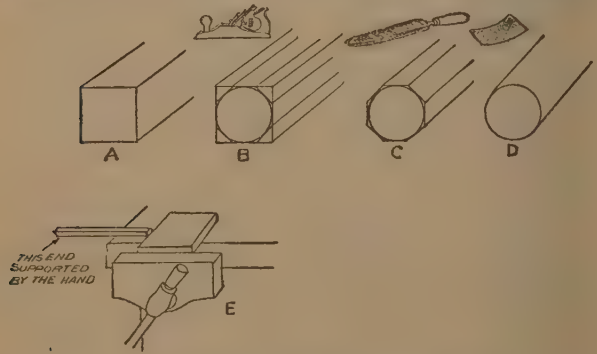
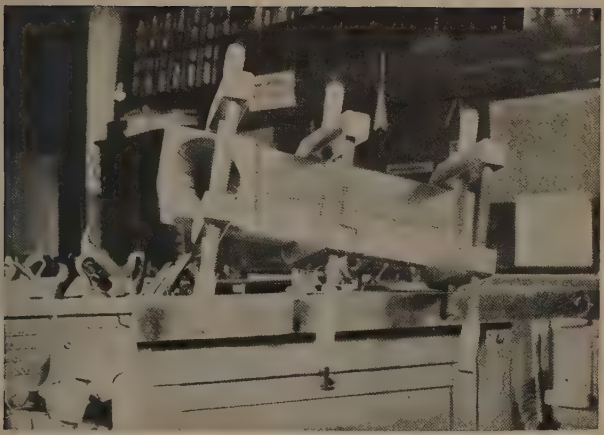


Fig. 41. How to Make a Round Stick.

that desired for the round rod. At each end, scribe a circle. Make short diagonal lines at each corner, such lines touching the circumference and terminating at adjacent sides. With the gauge, run lines from these diagonal terminals to similar terminals at the opposite end of the stick. (See *B.*)

Lay the stick upon the bench, arris down, forward end butted up against some sort of a stop, and holding the other end in your free hand, off the bench (see *E*), plane off the upper arris, thereby creating two arres and performing the operation called chamfering. At



CLAMPING UP GLUED WORK WITH HAND-SCREWS

PLANING OUT A ROUND ROD

C the stick is shown with four such chamfers made, which has resulted in the former square stick being converted into an octagonal or eight-sided rod.

The eight arres or ridges thus formed are next dressed down to the circles on the ends. This creates sixteen sides upon the stick. Another light cut on each of the sixteen arres will diminish the ridges to such an extent that coarse sandpaper may be used in the

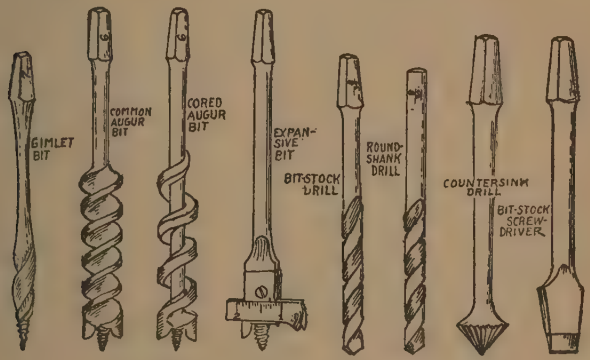


Fig. 42. Tools Used in a Brace.

palm of the hand to complete the rounding of the piece, as at *D*.

The Principal Tools Used in a Brace are shown in *Fig. 42*. These are inserted by opening up the chuck and pushing their tangs well down in the chuck's throat. To lock them in place, grasp the chuck in the left hand and turn the handle of the brace to the right until the proper pressure is applied to hold the bit firmly. (See *Fig. 43*.) To withdraw a bit, reverse this movement.

Auger Bits can be had in several styles; our illustration shows two of these. The first bit is a standard twist; the other, a cored twist. Sizes are generally given in stamped figures on the tang; if you observe an 8, it signifies that the bit is 8/16 or ½ inch

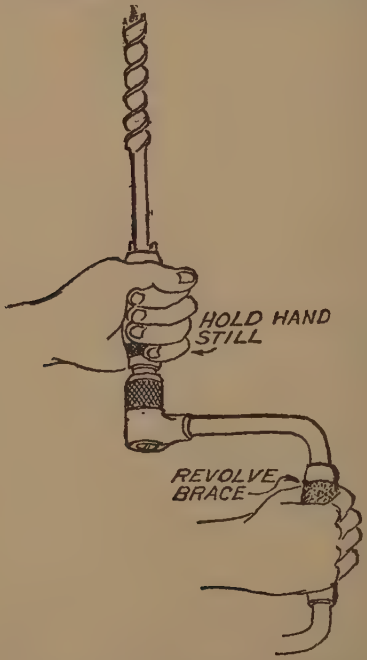


Fig. 43. How to Put a Bit in a Brace and Withdraw it Again.

in diameter. Standard sizes run in sixteenths of an inch from ¼ inch up to 1 inch. If you want to bore holes smaller or larger than these limits, you should get a few gimlet bits or drills for the smaller and an expansive bit for the larger.

An Expansive Bit is a general service bit which has a sliding cutter-plate by means of which various sized holes within the bit's range can be bored.

Twist drills, of which two types are shown, are not strictly wood-boring bits, but the smaller sizes can be used to fine advantage about the wood-working shop, and, if the larger sizes are sharpened to a long bevel, they also will work well in many places. Such drills come in two forms of tang—the bitstock tang and the round shank tang. Some braces will not grip a round shank, so with them the tanged drill should be used. But the smaller drills—those below ⅛ inch diameter—break easily in a brace, and it is better to get such sizes in round shank and drive them with a hand-drill. Drills above 1/16 inch are numbered in thirty-seconds; those below that size are numbered according to a template standard.

Gimlet Bits (*Fig. 42*) are used chiefly for boring holes to receive wood-screws. They are numbered in thirty-seconds of an inch. There is not much use of getting one smaller than No. 3, nor larger than No. 7.

A Counter Sink (*Fig. 42*) is used for enlarging the outer portion of a screw-hole so that the beveled head of the screw may not protrude above the surface. Beveled holes of varying size can be made with the same tool, according to the depth it is driven.

A Screwdriver Bit (*Fig. 42*) is very useful when you have many screws to drive, or when the screws go down with difficulty. Needless to say, these tools will not work well unless they are shaped to fit the slot of the screw.

Boring is not as simple a process as the novice would think. Two huge obstacles that he always encounters is boring a hole without splintering its edges and boring a hole plumb. The latter operation is, of the two, the most difficult to acquire, but a good eye and care will master it.

Some jobs can be done better by boring perpendicularly; other jobs will handle to advantage if bored horizontally. You must be governed by conditions in making your choice of methods. As a rule, greater force can be exerted upon the bit when boring horizontally (*Fig. 44A*), making it "bite" harder and bore faster; but, on the other hand, the perpendicular position makes it easier to "sight" the work from right-angular positions and determine thereby whether you are boring plumb or not. (See *Fig. 44B.*)

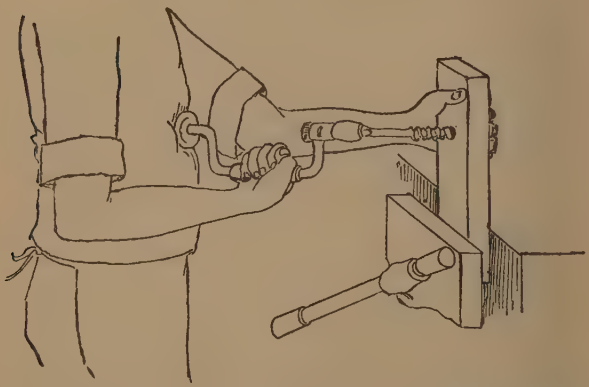


Fig. 44 A. Horizontal Boring. Feeling for the Spur of the Bit.

Boring can be done in the vise of the bench, on the sawhorses, and sometimes on the floor, but in the latter case a scrap block should always be placed under the piece being bored in order to prevent the bit suddenly going through and injuring the floor. If possible to avoid it, do not bore on top of the bench.

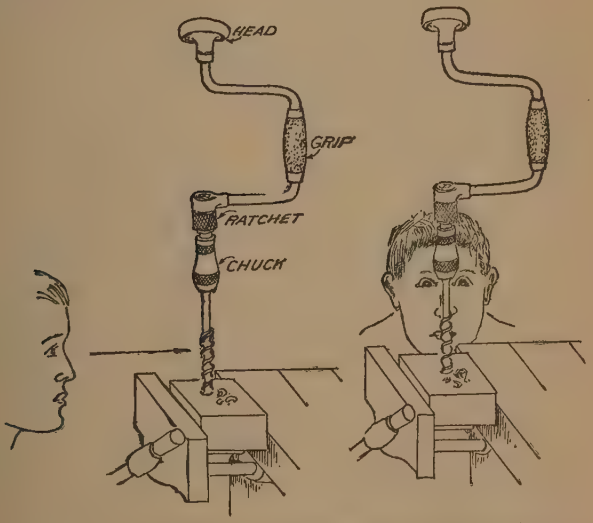


Fig. 44 B. Plumbing Perpendicular Boring in a Vise.

Never start to bore a hole without first pricking a center for the spur, as it may otherwise slip out of position on a hard bit of grain. Make sure, too, that you have the proper sized bit. If there is anything to fit in the hole, bore a test hole in a piece of scrap wood before operating upon the good piece.

If you bore right on through the board with an

auger bit, the wood will split out on the under side. To prevent this, keep the left hand on the back of the board (*Fig 44A*), just ahead of the bit. If you are doubtful as to having located your hand in just the right spot, keep it slowly moving up and down; it will come in contact with the spur before it is too late. As soon as you detect the appearance of the spur on the far side, turn the wood around in the vise and complete the boring from the unbored side.

Stopped-boring is often called into play, and you should learn the rudiments of this before attempting such an operation. Stopped-boring is the process of boring holes partly through a piece of stock and stopping at a predetermined depth. Bit gauges can be bought for this sort of work, but most of them are clumsy affairs decidedly inefficient. You can make your own bit gauge by boring a hole lengthwise through a round stick and slipping this over the bit, thus providing a shoulder which will not let the bit go beyond its intended depth.

After boring, clean out the shavings in all holes by inverting the board and vigorously thumping it with the palm of the hand.

If the bit, in going into hard wood, fails to act, take it out and inspect the spur. Very often in such cases the spur threads are found gummed up with pitch. Clean out the threads with a sharp point.

Draw-knifing is a speedy way of removing surplus wood, but careful study of the grain should be made before taking off a shaving, for otherwise there might occur a disastrous split. To pare down wood on an edge, first take off a shaving along each arris, pro-

ducing two rough chamfers, as at *A* and *B, Fig. 45.* Remove the central portion of undesired stock to within a close margin of your finished line. Plane down the remainder.

Remember that a shearing cut can often be made to

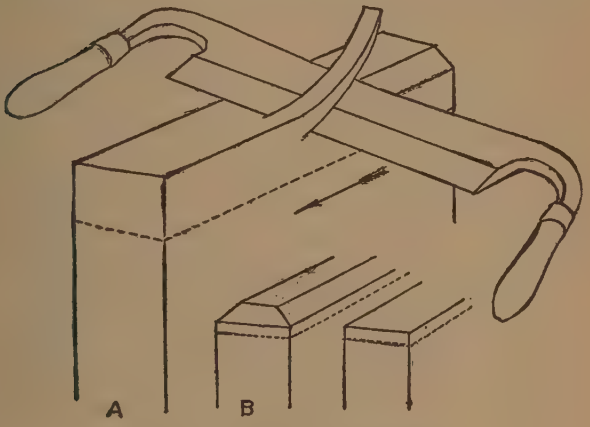


Fig. 45. Using a Draw-knife.

advantage with a draw-knife. Also remember that, when paring, the bevel of the tool should turn up.

Spokeshaving is a process much like draw-knifing, but the spokeshave is a finishing tool while the draw-knife is a roughing-down tool. The spokeshave, furthermore, is pushed, not pulled. It is usually employed on curved work, but there are occasions, such as when smoothing down the end of a very small stick, that it can be used for straight work to a limited extent.

As an example of the use of a spokeshave, several

views of a circular bread board are shown in *Fig. 46*. The first operation is laying out the shape with the dividers, as at *A*. After the rough-sized piece is cut out with the hand saws, and the corners marked off, as at *B*, the small corners resulting (see *C*) are marked off and sawed.

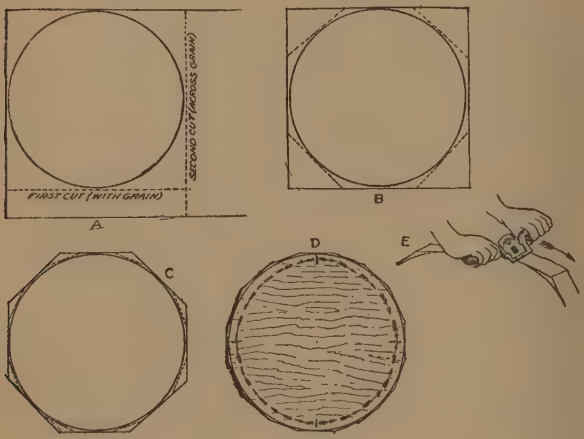


Fig. 46. Steps in Laying Out and Shaping a Disc.

In dressing down this uneven edge, a spokeshave is called into service. If it is out of adjustment you loosen the setscrew, set the tool flat on the bench, chuck the cutter down upon the bench, tighten the setscrew, then go to shaving. The directions of cutting are shown in *D*. You will note that there are four changes before you get entirely around the circumference.

At *E* is shown the correct method of holding a spoke-

shave while engaged in rounding the aforementioned bread board.

Smoothing Wood is the last process applied to it before painting or applying other protective coverings. It is a bad practice to do a little tool work on a piece of wood, then sandpaper the part done, then tool another portion, then sandpaper that, and so on. Such a procedure is not only wasteful in time, but it is likely to be detrimental to the tools, whose keen edges are very sensitive to the hard grit that sandpaper often leaves in the surface of wood over which it has passed.

Scraping is the quickest method of reducing the imperfections left on hard wood surfaces by edged tools. Soft woods will not respond to the use of a scraper. Their surfaces are too pliant to withstand the pull of the scraper's edge.

Sandpapering, however, makes a very good final smoothing operation for either soft or hard wood. This material is sold by the sheet, which runs about 12 inches square, and comes in the following grades:

No. 2. Very coarse; used for removing deep blemishes.

No. 1½. Medium coarse; used for blemishes of slightly more than medium depth.

No. 1. Medium; used for blemishes of medium depth.

No. ½. Medium fine; used for blemishes of that type.

No. 0. Fine; used for very small blemishes.

No. 2-0. Double fine; used to polish.

Do not tear sandpaper; cut it with snips. If you

have no snips, fold the paper, creasing it hard, then open it and tear.

Wrap the paper around a level block for smoothing flat surfaces. Hold it in the palm of your hand, or over your fingers, or over a round block, when treating curved surfaces.

Remember that sandpapering across the grain will leave scratches. It is sometimes advisable to rough out deep defects in this fashion, but be sure to remove the resulting scratches with a finer paper operated in the direction of the grain.

VI

JOINERY

Joinery is that branch of wood mechanics which has to do with the joining together or assembly of the various pieces of stock that go to make up a certain piece of cabinet-work.

Nails are probably the simplest form of fastening agent used in joinery. These can be had as long as 12 inches and as short as ⅜ inch. They are made out of various metals, are given various finishes, and come in a variety of form as to body and head.

For use in heavy timbers, we have spikes, which run from 3 to 12 inches long. For rough use in house construction, there is the common nail; for fine work in interior construction, the casing nail, finishing nail, and brad; for lathing, lath nails; for shingling, shingling nails; for plasterboard, plasterboard nails; for prepared roofing material, roofing nails; for shade rollers, shade nails; for outbuilding hinges, hinge nails; for wagon repairs, wagon nails; for boat repairs, boat nails; for house siding, siding nails; for fence repairs, fence nails; for boxes, box nails; for crating, coated nails; for decorative purposes, the upholstering nail and the brass escutcheon pin.

Nails 6 inches long and under are sold according to the "penny" (*d*) designation; those over 6 inches long are sold by lineal length. (See accompanying table.)

Lineal Length	*Trade Designation*
1⅛"	2-d
1¼"	3-d
1½"	4-d
2"	6-d
2½"	8-d
3"	10-d
3½"	16-d
4"	20-d
4½"	30-d
5"	40-d
6"	60-d
7"	7"
8"	8"
9"	9"
10"	10"
11"	11"
12"	12"

Fig. 47 shows some of the chief fastening devices that drive in with a hammer. Each of these is espe-

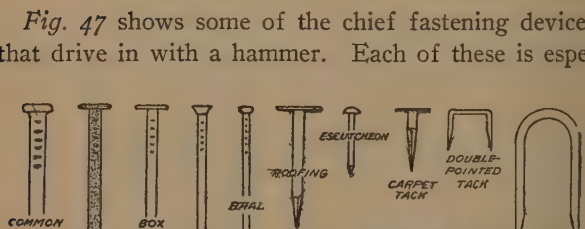


Fig. 47. Nails and Other Fastening Devices that Drive in with a Hammer.

cially valuable when used in the place adapted for it. All of them, except the corrugated fastener and the round-headed upholstering nail, are sold by the pound.

Hammers required about the average home may be limited, in most cases, to the common hammer and the brad hammer, although there are other types of

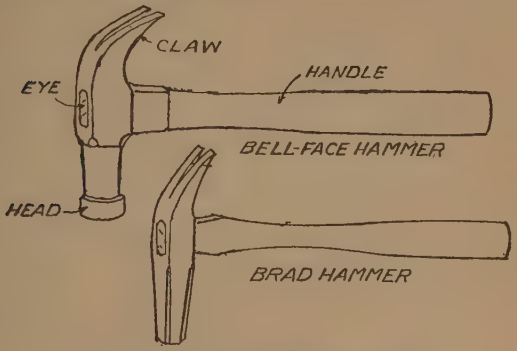


Fig. 48. Two Useful Hammers.

hammers which will be found great helps in keeping up home repairs other than woodwork, such, for instance, as the shoe hammer, described in Chapter XX of this volume. The two hammers illustrated in *Fig.*

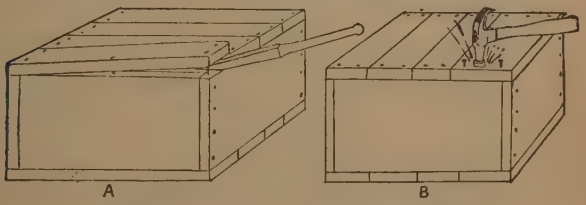


Fig. 49. Opening a Wooden Packing Box.

48 are typical examples of home hammers. They should be of good quality steel, and of the weights given in Chapter I.

To Open a Wooden Box, such as you might receive packed with merchandise, it is well to be provided with a pry bar or an old wood chisel. Drive the tool under the board to be removed, forcing it up a

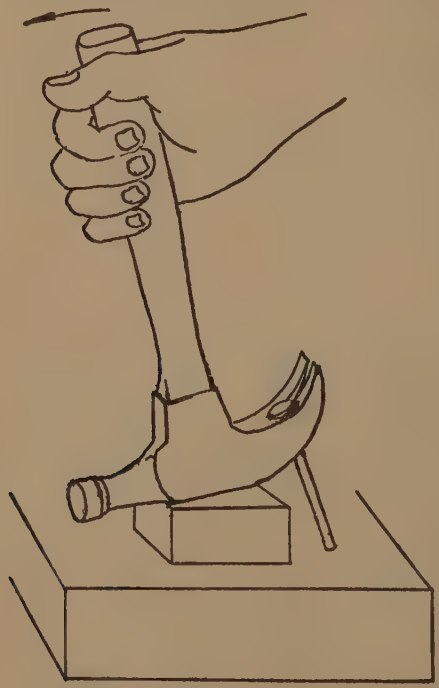


Fig. 50. Withdrawing a Long Nail.

little way, as at *A, Fig. 49.* Strike the hammer between the partly-loosened nails, forcing the board back again and the nail heads out of the wood. (See *B.*) Remove the protruding nails by placing a block under

the head of the hammer, as in *Fig. 50*, pushing the hammer over until the nail is completely out.

Old Nails should not be thrown away. Practice thrift; straighten out the bent ones by hammering them on a bar of metal, then lay them away for future use.

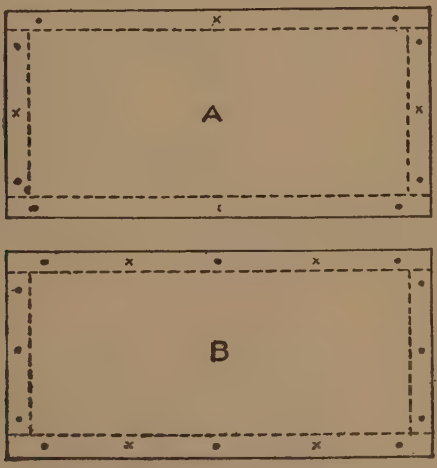


Fig. 51. Placing Nails Uniformly.

The Placement of Nails is an important consideration to every good mechanic. Nothing looks worse, without it is protruding nail points, than nails which, in an otherwise nice piece of woodwork, have been unevenly spaced. Nor is it necessary to use a rule or dividers for marking nail positions. Merely gauge a pencil line the proper distance in from the edge; drive your first nails near the corners (*A, Fig.*

51); the next ones are placed as nearly half-way between as your eye will determine; and if there are to be more nails they are placed half-way of the new spaces produced. (See *B, Fig. 51.*)

Driving a Nail is not the simple thing it might appear. It takes skill and a good eye to put down a nail without bruising or splitting the wood. The ten-

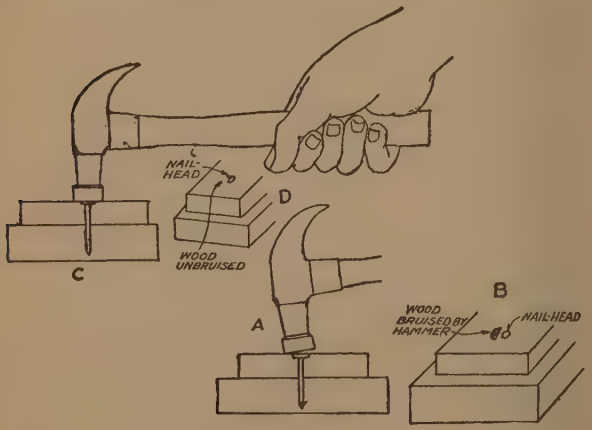


Fig. 52. How to Drive a Nail.

dency of the beginner is to hold the hammer too close to the head, and to strike the nail—if he does not miss it—at an angle, so that when the nail head reaches the surface, the hammer's face bruises the wood in the manner shown at *A* and *B, Fig. 52.* To see how to hold the hammer, likewise how to strike with it, refer to *C* and *D,* in the same illustration.

Setting Nails is the proper practice wherever the heads will mar the appearance. To set them, use a

tool called a nailset, which is really a sort of punch, and drive the heads about 1/16 inch below the surface, later filling the cavities with putty or similar fillers, directions for the application of which will be found in Chapter XII.

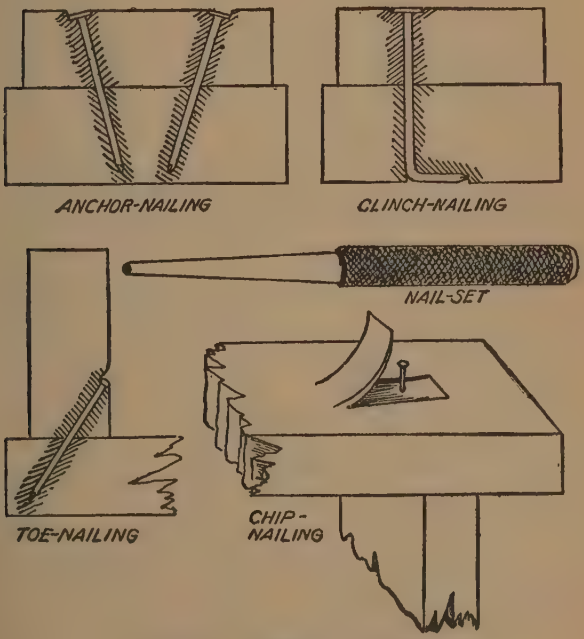


Fig. 53. Methods of Nailing.

Anchor-nailing (*Fig. 53*) makes a stronger job where two pieces are to be fastened together and the nails are not to be clinched. This method of nailing is a simple one, consisting of merely driving the nails in at opposing angles.

Clinch-nailing (*Fig. 53*) makes the strongest kind of nailed joint. The only serious drawback to this method is that it presents a rough appearance, but there are places, such as in packing-box construction, where this defect is unimportant. To clinch a nail, first drive it through both boards, then place the head upon an iron bar or a hard piece of wood and bend over the protruding nail, driving it well into the wood, diagonally across the grain.

Toe-nailing *(Fig. 53)* is another process of uniting two pieces of wood. It is generally used where there is no other way to get the nail into the parts required. The nail is driven in at a slant. To do a nice job of this kind, cease striking the nail head with the hammer as soon as the head is within a half-inch of the wood. Finish by using the nailset, which will prevent damaging the wood with the hammer.

Chip-nailing (*Fig. 53*) is one of the finer kinds of cabinet nailing. It provides a manner of entirely concealing the nail head without filling any cavities. To perform this trick, force a sharp chisel into the wood, peeling up a thin chip. Drive your nail under the curling chip, then glue the chip in the cavity from which it was raised.

Nailing in Hardwood requires a tight-fitting hole previously made in the upper piece.

Screws are another medium for fastening together pieces of wood, and are often employed about the home in such places as require possible removal at some future date, or where greater strength is needed than that afforded by nails.

The most popular types of wood screws are shown in *Fig. 54*. The flat-head, round-head, and oval-head screws are designed to be driven with a screwdriver; the lag screw has a square head and is driven with a wrench. Lag screws are used where unusual stress will come upon the parts to be connected.

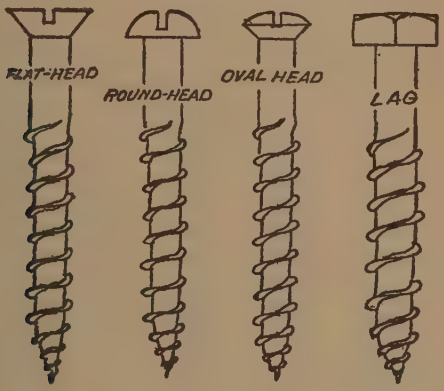


Fig. 54. Common Kinds of Wood Screws.

Wood screws are made in standard sizes running all the way from ⅜ to 3 inches in length. The diameters are designated by wire-gauge standards and are in whole numbers, which have nothing in common with a rule's dimensions. If you have no wire-gauge, it is best to select your screws by measuring your wood or an old one, then advising the clerk at the store.

Flat-head Screws are intended to set deep enough in the upper piece of stock to bring their heads flush with the surface; therefore, the holes to receive them must be enlarged above to accommodate the entire

screw head, as shown at *A* of *Fig. 55*, this enlargement being done with a bit called a countersink, which was described in the preceding chapter. Test for fit by inverting the screw, as in *Fig. 58*.

Round-head Screws rest with their entire heads projecting, as at *B*, *Fig. 55*.

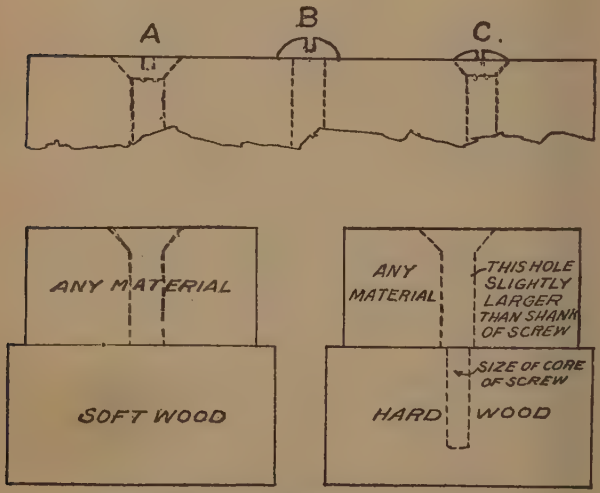


Fig. 55. How Screw Heads Meet the Wood.

Oval-head Screws are countersunk as far as the beveled portion of their heads, the oval section projecting. (See *C* of *Fig. 55*.)

Driving Screws (*Fig. 55*) requires thought and care, to do a neat piece of work. In the first place, do not attempt to screw together two pieces of wood without first boring a hole through the upper piece to receive snugly the shank of the screw. If the grip-

ping, or under, piece of stock is soft wood, it will not be necessary to bore into it, but if it is hard wood the screw will not go in readily without you bore a hole in the wood the size of the core or solid center of the screw.

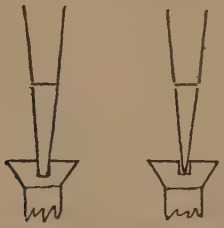


Fig. 56. Well-Fitting and Poor-Fitting Screwdrivers.

To Start a Screw, tap it sufficiently hard to make it stand upright. Before attempting to turn it in, note whether or not your screwdriver is properly ground to fit the slot. If there is much play, the driver will tear out the sides of the slot; if the driver is too thick,

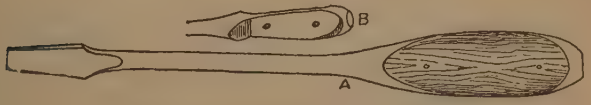


Fig. 57. A Well-Made Screwdriver.

it will keep twisting out of the slot and probably punch into your wood, damaging it. (See *Fig. 56.*)

The best type of screwdriver is that which has a flattened shank to which the handle is rivetted, as the one shown in *Fig. 57.*

Countersinking is the process of enlarging a screw hole so that the head of a flat-headed screw will

set flush with the wood. The tapered enlargement is made with a special bit called a countersink. Bore this in the hole just far enough to let the screw head down, testing, now and then, by inverting the screw in the manner shown in *Fig. 58*.

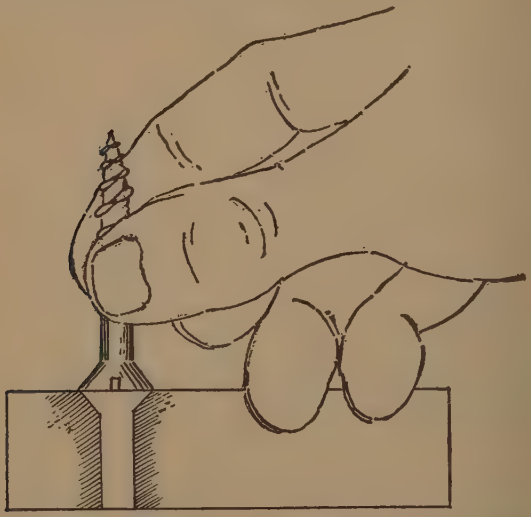


Fig. 58. Testing the Fit of Screw Head in a Countersunk Hole.

If a Screw is Too Long for a certain place, and you cannot readily secure one of the right size, turn in the long screw to the depth desired, then withdraw it, grind off the point the required amount to reduce it to the length wanted, and drive it into the head.

If a Screw Head Should Break Out while operating the screwdriver, draw the screw with a pair of pliers. If there is insufficient screw exposed to get a grip, drill a small hole down into it and force a wire

nail into the hole very tightly. Bend over the nail, and use pliers or a light wrench to turn the screw.

A Little Soap Rubbed on a Screw will often assist in driving it in hard wood where the core hole has been made a trifle too small.

After the Screw Has Been Driven to Position, feel of its head to ascertain if the screwdriver has thrown up any steel burrs. These should be filed off, if they exist.

Glue is another medium for fastening wooden parts together. In fact, it is the neatest, and often the strongest, fastening agent employed in joinery. If the meeting surfaces are true and in perfect contact, and a good job of gluing is done, the joint will be stronger than the surrounding wood.

For home use there are two kinds of glue that interest us—cold glue and hot glue.

Cold Glue comes prepared; it is in liquid form, and is a very good adhesive for sticking together small parts which in use have no great strain put upon them. It takes from twelve to twenty-four hours for cold glue to harden sufficiently to hold the parts in place, and twice that long for it to become hard. Should it get thick from exposure to the air or to cold temperature, you can thin it with vinegar or by heating.

Hot Glue is prepared by the user. Buy the flakes or chips at a hardware store, and make up a batch of glue in the following manner: Fill the inside container of the glue pot about half-full of flakes. Pour on just enough cold water to cause it to reach the top of the flakes. Let this stand about four hours, when the glue will have become a jellified mass. Pour enough water

in the outer vessel to reach about half-way up on the inner container. Set the glue pot on a moderate gas blaze or other heating element. In fifteen minutes a skin will have formed over the top of the glue and the flakes will have become thoroughly dissolved. The glue is then ready to use.

This glue will begin to thicken as soon as removed from the fire. For this reason, it should be used quickly, if it must be removed for doing a job, for chilled glue will never hold well. When you wish to reheat such glue, after it has become hard, add a very small amount of water to the inner container and put the pot on the fire again, after assuring yourself that the outer container is also supplied with enough water to keep the glue from burning, a condition which renders it worthless.

When the glue supply in the kettle gets low, put in a fresh supply of glue flakes on top of the old glue, which must be hard. This can be done a time or two, but the best results come from using all fresh glue.

Hot glue will set in six hours, and harden in twelve hours.

Gluing requires some skill. You must also be neat about the work or you will soon be in a terrible mess, have yourself beautifully daubed up and your pieces in a like condition.

As stated before, the first fundamental in gluing is to produce a perfect fit of the parts to be joined. Glue will not fill up cracks and similar openings. Part must touch part, in complete contact. Nor will glue stick to greasy or dirty surfaces.

Another fundamental is to fit your parts together and clamp and inspect them in a dry condition, before the glue is applied. If the fit is good, the glue job will be likewise good, providing you use a good quality of glue and do the final clamping quickly and efficiently.

Work fast while gluing. Use a brush and coat both surfaces. If there are a number of joints to be done

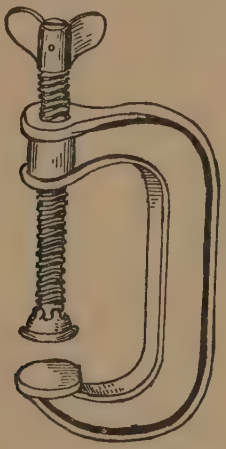


Fig. 59. A Quilting-Clamp.

at the same time, have somebody help you. Put buffer blocks or felt under the clamp heads to prevent injury to finished surfaces. Test your frame for general squareness, as well as tightness of joints, before you set it away to dry.

Clamps for Gluing Jobs can be extemporized from snap clothes pins, string, rope, spring clips, etc. Quilting-clamps, such as shown in *Fig. 59*, can be utilized in many places. You can even saw out a notched

clamp, using a narrow strip of board, as in *Fig. 60*, for other kinds of work. And if you want clamps more professional in aspect, you can get iron clamps and bar clamps and hand screws at the hardware stores in various sizes and adapted to almost any job that may come up.

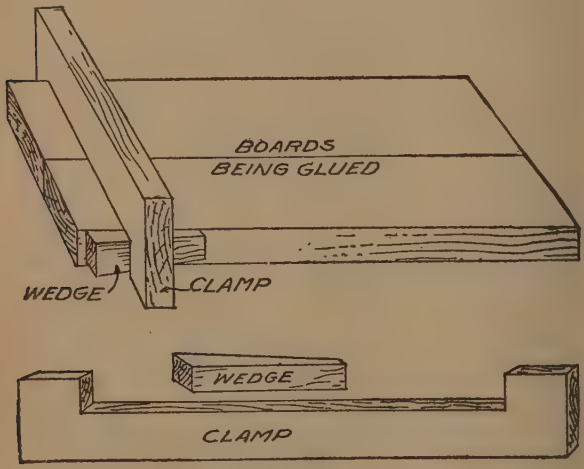


Fig. 60. Notched Clamp Made Out of a Strip of Board.

An Emergency Glue Pot can also be produced at home. To make this device—which is only a makeshift until you can purchase a good copper kettle—take two empty cans or other similar household vessels, the idea being to have one small enough to be contained within the other. In the bottom of the larger vessel set two or three tin supports, bent to a U-shape, as shown in *Fig. 61*. These supports can be made from almost any scrap tin, and are for the purpose of

letting the boiling water of the outside container freely circulate beneath the smaller vessel.

Wood-working Joints which the home mechanic is likely to need in rendering repairs about the premises, are illustrated in *Fig. 62*. All of these are first care-

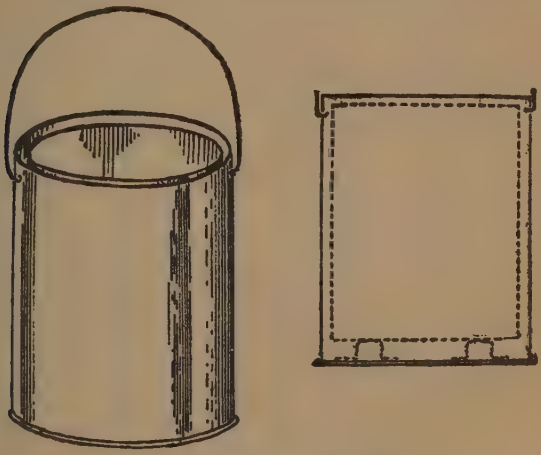


Fig. 61. A Home-Made Glue Pot.

fully marked out with such laying-out tools as the square and knife and gauge, and are then formed with the brace and bit, the saw, or the chisel and mallet.

It is customary, when making joints other than the dowel type, first to saw the cheeks or side-walls and to make the shoulder cuts last. Dowel-joints are marked by setting the pin in one member, then superimposing that part upon the other member and locating the position of the other hole, which is then bored.

Except where nails are shown in the illustrations, these joints are of the glued variety.

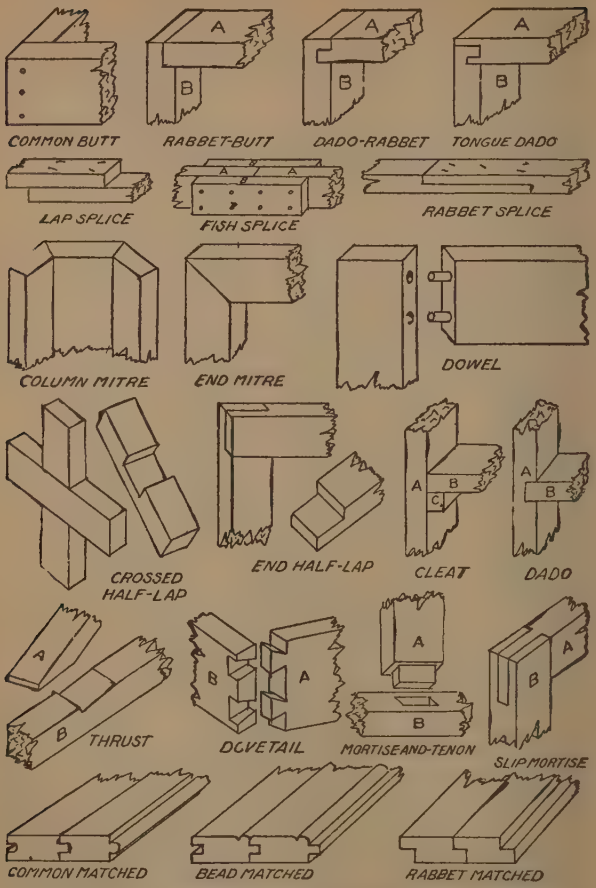


Fig. 62. Wood-working Joints That the Home Mechanics Should Know.

VII

WOOD-WORKING REPAIRS

THERE is hardly a week goes by in the average household but that some repair offers itself with wood-working tools. Indeed, sometimes it fairly "rains"

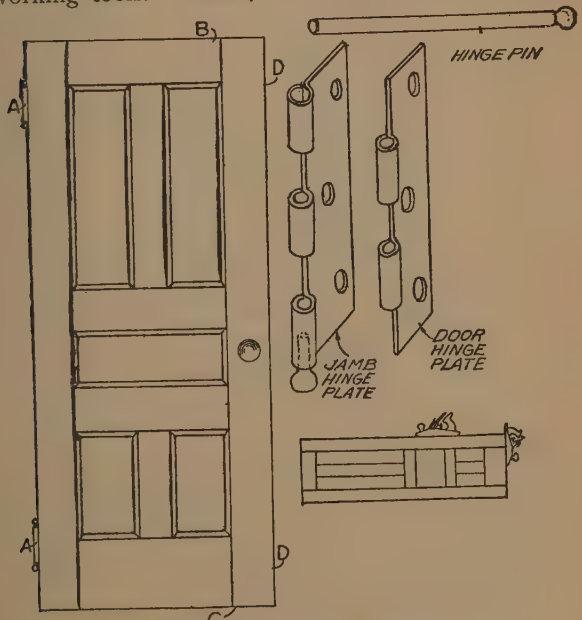


Fig. 63. How to Relieve a Sticking Door.

down repairs. It seems everything is going wrong at one time. Fortunate then is the man, woman, boy, or girl who has a little outfit of tools about the premises and who knows how to get the most out of them.

This chapter will deal with repair kinks which commonly occur about the home.

To Relieve a Tight Door permanently there is but one way—plane it. The chances are a damp spell of weather has swelled the framework, and, as you might have to wait a tedious long while for a

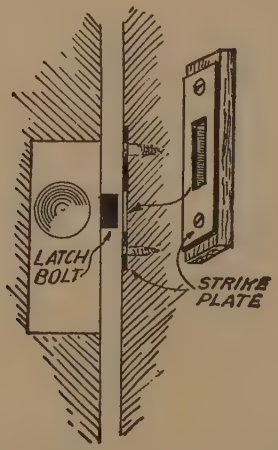


Fig. 64. How to Fix a Door that Is Too Narrow.

period of dry weather to undo the mischief, it is best to remedy the trouble without delay.

First carefully inspect the door, opening and closing it, to detect the exact spot or spots where it seems to be sticking. Mark the place with chalk.

If the door strikes only along the front edge, as at *D, D, Fig. 63,* or along the top edge, as at *B,* it can be dressed down without removing it. If, on the other hand, it sticks at the bottom or near the latch, the

door should be taken off its hinges. This can be done by removing the pins *A, A,* The door can be rested on its side and the bottom edge carefully planed. But if the tightness comes at or near the lock, the hinges should be removed and set in, after the back edge is dressed down. This is a more difficult job, but it

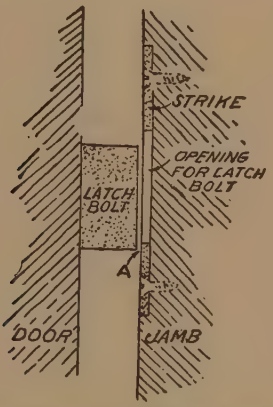


Fig. 65. How to Repair a Striking Latch Bolt.

is more workmanlike and avoids marring the front edge.

Repairing a Too-narrow Door (*Fig. 64*) is a somewhat fussier job. Such a condition is usually caused by the settling of the house foundation, and results in widening the threshold to such an extent that very often the bolt of the lock will not reach the strike plate. To remedy this, remove the strike plate and insert under it a shive of wood of a thickness which will bring the plate in effective reach of the bolt. If

it is an outside door, it will then be well to nail strips on either side of the strike plate, to fill up the openings below and above the plate.

To Relieve a Striking Latch Bolt you may adopt either one of two methods, according to conditions. (See *Fig. 65.*)

Fig. 66. This Relieves a Door that Binds at the Back Edge.

Method No. 1.—If the upper corner or lower corner *A* of the latch bolt strikes just a little, remove the strike plate and file the mortise to a sufficient enlargement to admit the bolt. Replace the strike plate and test the latching qualities of the door.

Method No. 2.—If the latch bolt strikes quite fully, remove the strike plate and lengthen the mortise on the proper end or side so that you can shift the strike plate the right way to bring it in alignment with the bolt. Punch or drill new holes for the screws, then

drive them down. If a new screw hole comes on the very edge of an old one, fill the old one with a tight-fitting plug, cutting off the projecting portion until none of the plug rises above the surface. Use a knife for whittling off the peg. Drive home the screws, and test. Restain any portions of wood made white.

To Relieve a Door That Binds at the Back Edge,

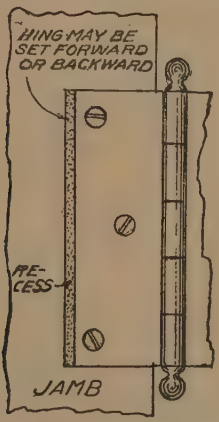


Fig. 67. This Straightens a Sprung Door.

loosen the screws in the hinge that seems low and insert a cardboard shim. (See *Fig. 66.*) This will set the hinge farther forward and throw the door farther over.

To Straighten a Sprung Door, remove the screws in the hinge or hinges affected, plug the screw holes, and either reset the hinge farther inward or farther outward, according to necessity. If the door springs outward, merely drive the screws down in the new lo-

cation; if it springs inward, chisel out more wood, so that the plate can make the shift. (See *Fig. 67.*)

To Prevent a Door Binding at the Bottom or Top, loosen the hinge screws that require it and slip a shim under the inner or outer edge of the plate, according to the nature of the trouble. (See *Fig. 68.*)

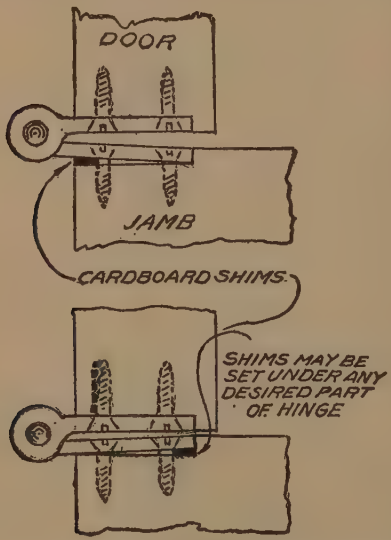


Fig. 68. This Relieves a Door from Binding at the Top or Bottom.

Rescreening a Door (*Fig. 69*) is not the difficult task that many householders believe it when they call in a repairman. When your screen door gets a hole in it and the flies begin to pour through, go to your nearest hardware store and purchase a piece of wire screening a little larger than actually required. Cut

this down with tinner's snips, so that it will fit the opening occupied by the broken screening, then pry up

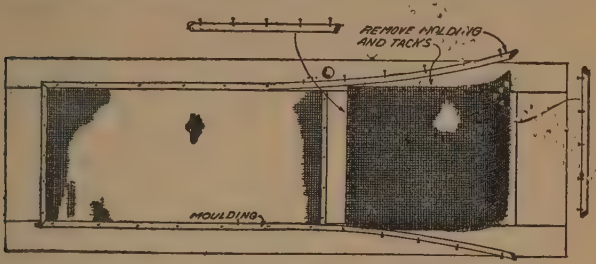


Fig. 69. How to Rescreen a Door or Window.

the molding and remove it, substituting the new piece of screening. Stretch this and tack it to the door frame. Finish by replacing the molding.

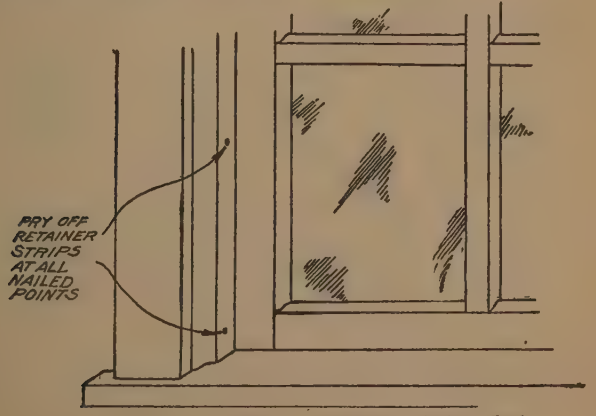


Fig. 70. How to Relieve a Sticking Window Sash.

To Relieve a Sticking Window Sash (*Fig. 70*) it is necessary either to patiently wait until dry weather

shrinks the swollen wood fibres, once more reducing the sash to a normal condition, or else use the plane. In the latter case, push a screwdriver or chisel under the retainer strip or stop molding at each side of the sash, and pry it out. Note at what point or points the sash is striking the window casing, remove the sash to the bench or floor and plane off the troublesome parts.

Weather-stripping a Window or Door never fails to shut out considerable outside cold. By all means put in weather strip if your windows and doors are not already so protected. Weather strip can be purchased at most hardware stores for a nominal price, but many householders prefer to make their own, which is not difficult to do. To make weather strip get out some thin sticks, about ¼ inch thick and ⅝ inch wide, and wind these spirally with strips of woolen cloth, tacking it in a few places to keep it from unwinding. (See *Fig. 71.*) Nail these covered strips along the

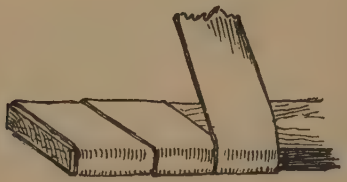


Fig. 71. Making a Weather Strip.

wide cracks of the door or window, so as not to interfere with the free movement of the door or sash, in opening or closing.

Where the cracks are quite small, use strips of cloth alone. The illustration in *Fig. 72* shows how such

strips may be applied to make the lower edge of the window sash cold-proof.

To Repair a Defectively Weighted Window Sash (*Fig. 73*), one that persists in falling when you raise it and let go, the first step is to remove the stops, which can be pried off with a chisel or screwdriver.

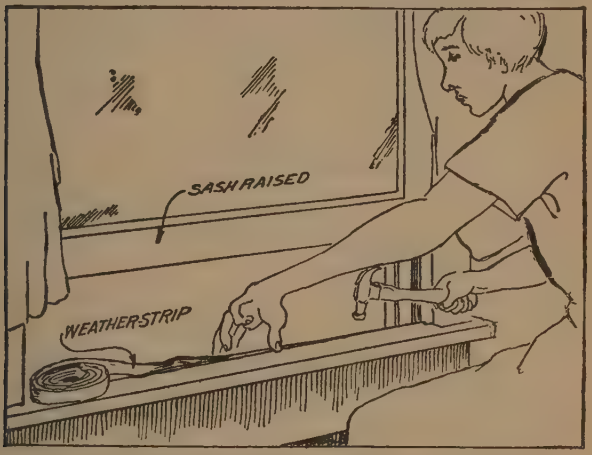


Fig. 72. Fixing the Window That Lets in the Cold.

Then raise the lower sash. This will disclose a beveled cover to the weight pockets in the casing. Remove the covers, whereupon it will be an easy matter to pull out the dangling weights for repairs.

As a rule such trouble is caused by the sash absorbing moisture or paint and becoming too heavy to counterbalance the formerly correct weights, or by stiff pulleys wearing loose. If the overweight of the sash is slight, an easy repair often can be made by removing the weights from the cord, slipping a short

piece of gaspipe on, and retying. If the overweight seems considerable, remove the sash from the casing

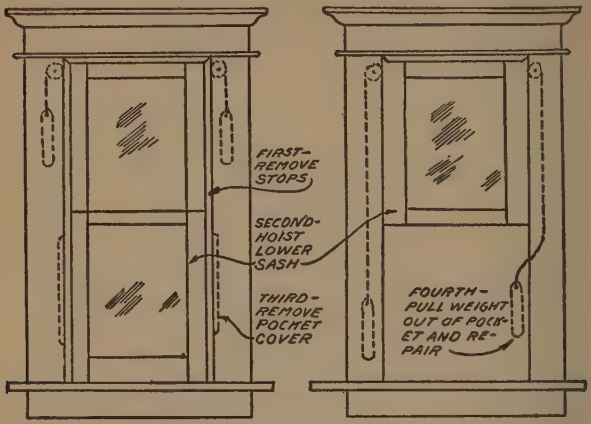


Fig. 73. To Repair a Poorly Working Window Sash of the Weighted Type.

and weigh the sash; then buy two new weights whose combined weight are as near equal to the sash's weight as possible.

Sash weights are sold by the pound, and, therefore, can be secured to counterbalance practically any window sash. Nearly all hardware stores carry them in stock, and new sash cord can also be obtained for making repairs to cord which has become frayed out or broken.

Sometimes pulleys get rusty and run hard. In such cases, remove the window stops and drop oil on the pulley bearings.

To Repair a Sash Spring, when it fails to operate, insert a screwdriver under the flange of the barrel, as

shown in *Fig. 74,* and pry out the entire apparatus. Inspection, while snapping the bolt back and forth in your fingers, will quickly disclose the trouble. If the coiled spring should fail to expand quickly when you release the bolt head, the barrel is probably dirty inside and needs cleaning and a few drops of oil. If you find the spring broken, you might as well buy a new complete device, as they are so cheap they can be replaced for the price of a spring alone.

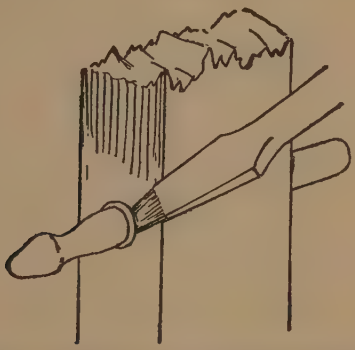


Fig. 74. Replacing a Broken Sash Spring.

Sometimes sash spring bolts are all right in themselves, but fail to support the sash because the holes in the jamb are worn out. In such an event drive plugs in the holes and then rebore.

To Repair Loose Chair Rails or Rungs, first find out whether or not the dowelpins of the rails or the ends of the rungs are broken off. If they are intact, force the legs of the chair as wide apart as possible and apply glue to the pins. (See *Fig. 75.*) Then push the rails and rungs in place, and hold them there

by wrapping some light rope around the chair and twisting the rope up taut by means of a "key" made from a piece of wood, as in *Fig. 76*.

Another way to hold the formerly loose parts together while they dry is to drive brads into them from the inside of the chair. (See *Fig. 77*.) In an emer-

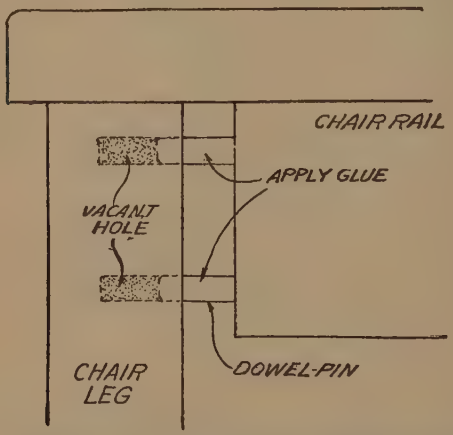


Fig. 75. Regluing a Loose Chair Rail and Thereby Strengthening the Leg.

gency, nails alone, applied in this manner, may make the chair more rigid, but it is better to glue all loose parts when possible.

When Dowelpins Are Broken Off, the only way to make a good repair without taking the chair all to pieces, is to bore a hole straight through the chair leg and on into the rail or rung, such hole being, of course, the correct size to fit a new dowelpin, which you must shape out of hard wood with your tools. Apply glue

to the holes, then drive in the pin, cutting it off flush with the outside of the chair leg. Stain the visible end of the pin to match the chair as much as possible, and apply a coat of wax or shellac to it.

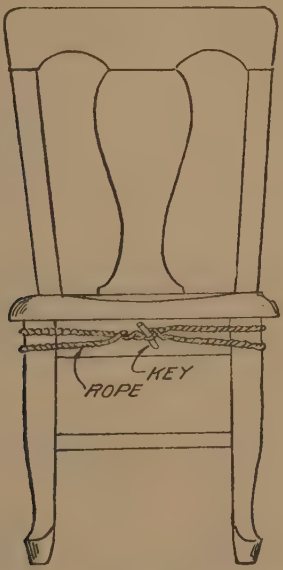


Fig. 76. A Handy Way to Hold Freshly Glued Parts in Place while Drying.

To Reseat a Chair (*Fig. 78*) remove the old covering, whether it is cane, fabric or other material, and take a measurement of the opening in the center of the seat frame. At a hardware store secure a cane seat, or one made of fibre, large enough to cover your chair nicely; also purchase a box of brass-headed or leather-headed nails (suit your taste here) with which

to nail on the seat. This is an easy task; almost any boy, girl, or woman can do a good job at it, and the result will be very satisfying, for an old chair thus renovated becomes useful once more; indeed, it becomes very pretty if given a couple of coats of white or blue enamel, directions for applying which will be found in Chapter XV.

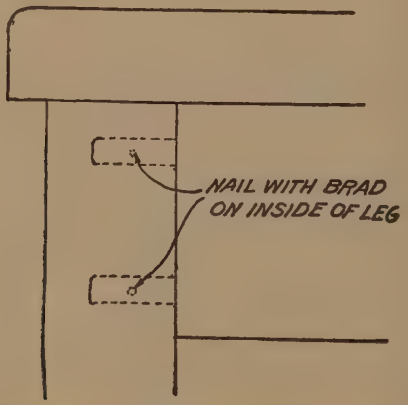


Fig. 77. Nailing a Loose Chair Rail that Cannot Be Reglued.

To Make a Chair Slide Easier, such as dining-room chairs, all you have to do is to buy four so-called gliders, invert the chair, and hammer one glider on to the bottom of each chair leg. (See *Fig. 79.*)

Relieving a Sticking Drawer (*Fig. 80*) is accomplished by first noting the exact source of trouble, then withdrawing the drawer and setting it on the bench or the floor and planing down the striking portions. Sometimes these parts will be found on the bottom;

sometimes at the sides. Never dress off the top, as it will destroy a finish that shows. When the fit is made

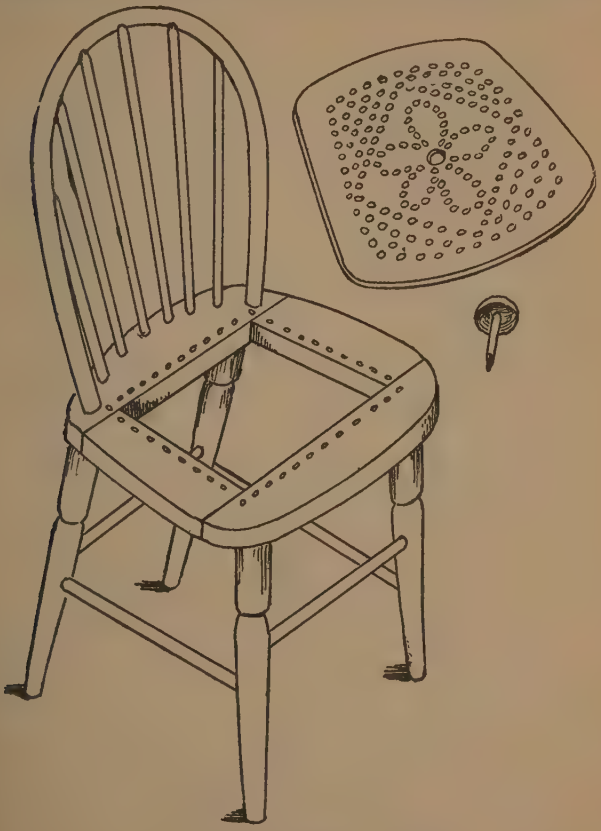


Fig. 78. Reseating a Chair.

good, apply a little paraffin on the bottom edges or runs, which will do wonders in making the drawer work

easily; in fact an application of paraffin is good for any drawer, whether it sticks much or not.

Refitting a Table Leaf sometimes becomes neces-

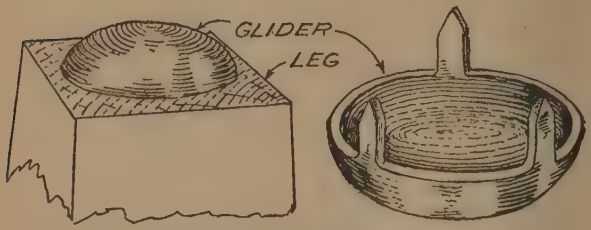


Fig. 79. How to Make a Chair Move Easily Over the Floor.

sary owing to the fact that damp weather has warped and twisted the meeting edges. If two leaves meet in the ill manner shown in *Fig. 81*, withdraw the steel

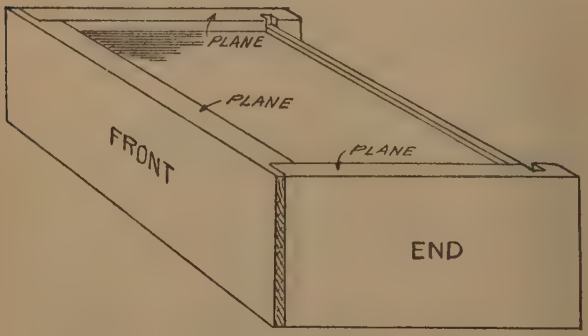


Fig. 80. Remedying a Tight-fitting Drawer.

dowelpins with pliers, then replane the defective edges until they come together as they should. This operation will reduce the depth of the pin holes; therefore,

you should bore them a trifle deeper before replacing the pins.

To Repair a Broken Pin in a Window Shutter

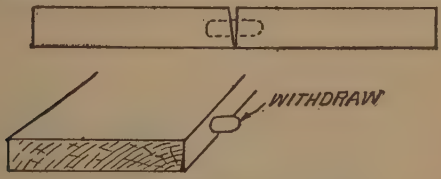


Fig. 81. Refitting a Table Leaf.

(*Fig. 82*), which is the chief ailment shutters seem to contract, cut off the stubs, rebore, and fit in a new

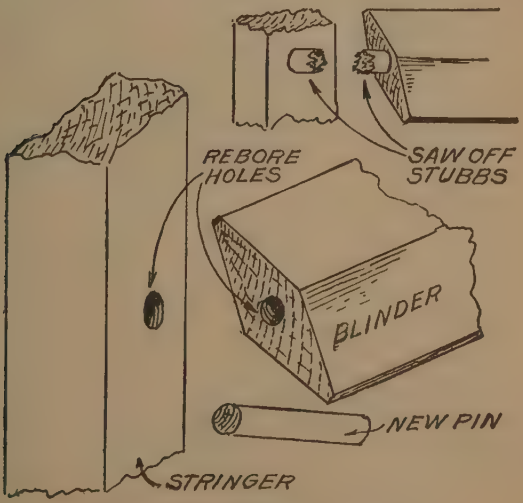


Fig. 82. To Repair a Shutter.

pin. The pin can be made right at home, with a knife, file, and sandpaper as tools. Do not have too close a

fit, as rainy weather will swell the pin and cause the blinder attached to turn hard.

To Reshingle a Leaky Roof used to be more of a task than it is to-day; the popular asphalt and rubberized shingles of the present do much to reduce the hard-

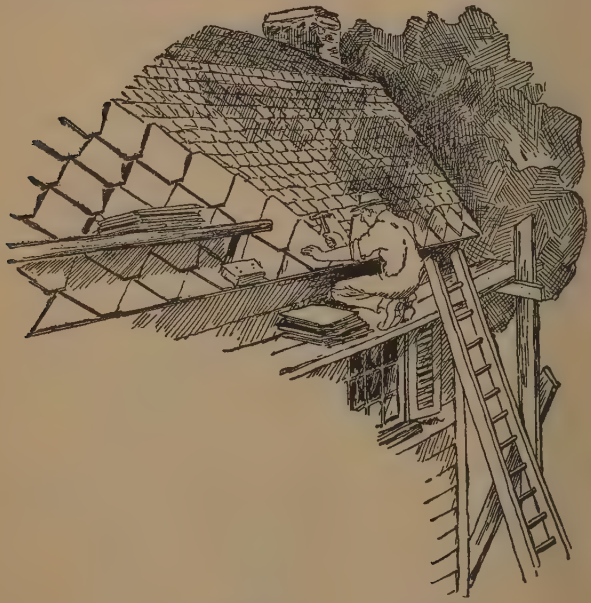


Fig. 83. Reroofing Over Old Shingles.

ships of the job. Many people engage professional roofers to repair their buildings, then complain about the price they have to pay, whereas, had these homeowners had a little more confidence in themselves and some knowledge of the work, they might have saved a tidy sum.

You must be a fairly active fellow, of course, in order to do the necessary climbing and squatting attendant to a reshingling job. Take some old boards and a few 2 by 4's and rig up a scaffolding just below the evetrough, along one side. Our illustration, *Fig. 83*, shows a section of such a scaffolding, and ought to be sufficient guide for you to put together a complete one. In this operation, fasten one 2 by 4 to another, if one is not long enough, lapping the ends at least a foot. Stand these upright, and nail braces diagonally across to the end of the house, to support them. Do not drive the nails that go into the house all the way in; leave enough of them projecting to allow of extraction with the claws of the hammer.

Next fasten a strong board horizontally across from upright to house, attaching the house end of the strip to a cleat nailed to the building. On the crossboard the planks or platform will rest. A ladder placed against the platform will give you ready access to it from the ground. In the beginning, the supply of shingles is kept on the platform, but as you progress up the roof with your layers of newly-placed shingles, it will be convenient to keep near you a portable shelf (something like that in the illustration) for holding the shingle supply immediately needed. Such a shelf can be made from one wide board about five feet long, supported at both ends by brackets made from board ends supplied with sharpened spikes in their bottom edges.

Some householders prefer to lay their new shingles right over the old ones. If the latter are not too badly rotted or curled this can be done, and it saves a lot of

work in ripping off the old shingles; but as a rule a better-looking job, at least, can be done if the old covering is removed. In case you take off yours, you will find your task made lighter if you will use a spade in the operation. Rubber-soled shoes will help you to stick to the roof. Pile the riff-raff in the yard, and later use it for starting fires in the stove.

Do not make the mistake of beginning to shingle

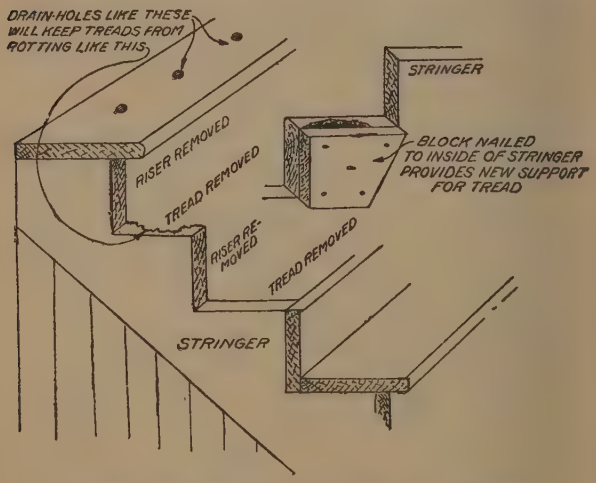


Fig. 84. Repairing a Rotted Porch Step Stringer.

along the ridge. In order to lap properly, so the rains will not run under, the new shingles should be started along the edge of the roof and the layers laid gradually upward. Use a chalk line for a laying guide. Trim the shingles neatly along the ridge line, then replace the ridge-board over them, nailing it securely down. Use extra nails in the shingles bordering chim-

neys and gutters, to insure a rain-proof flatness. Flashings of tin will aid around the chimneys.

A Rotted Porch-steps Sill is a common occurrence where eavestroughs are allowed to leak and drip water on the steps. The first effort should be to install a new section of troughing, of course; the next effort should be to repair or replace the sill. As a rule the rot will not have extended in a great way, probably no more than enough to have loosened the nails holding the tread. So a repair will be possible.

To accomplish this, remove the adjacent tread and nail a thick block to the inside of the sill, as illustrated in *Fig. 84*. The flush edge of the new block will provide a good rest for the tread, also afford a good grip for the nails.

If the sill is rotted past repair, it will be necessary to remove the wainscoting, treads, and risers, and saw out a new sill. The old sill will furnish you with a pattern for laying out the angular cuts.

VIII

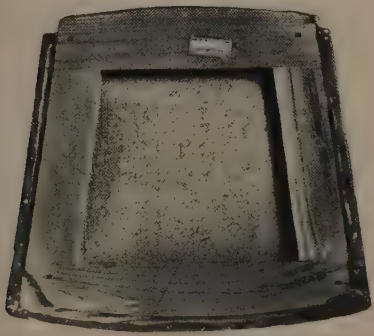
UPHOLSTERY REPAIRS

It is surprising how much longer the upholstered furniture of the home will last if there is a handy person about the premises who will constantly keep a watchful eye on it and make a repair the moment the need manifests itself. Probably two-thirds of the repair bills paid out to professional upholsterers could be saved by householders if they would only have confidence in their ability to cope with the simple upholstery troubles which arise within the four walls of their domiciles from week to week, month to month, and year to year.

The Tools needed in household upholstery repairs, besides those found in the average home workshop, are a gimp hammer, a webbing stretcher, a pair of scissors, a regulator, a straight needle, and a curved needle. These are shown—in addition to a few supplies, such as tacks, nails, and gimp—in *Fig. 85*. In fact, in a pinch, any light hammer can be used; the household shears will do in place of the regular upholsterer's scissors, and the regulator can be made out of a 10-inch piece of ⅛-inch wire by bending an eye in one end and sharpening the other end.

But that is not all; for you can also make the webbing stretcher, if you are the least bit clever with tools. Just cut out a block ¾ inch thick, 3½ inches wide, and 7 inches long. Hollow out the sides, as shown in the illustration, drive six 6-d nails in one end, cut off the

UNCOVERING THE SPRINGS TO MAKE REPAIRS



THE UNDERSIDE OF A SLIPSEAT, SUCH AS COMMONLY FOUND IN DINING CHAIRS

heads, pull out the nails with pliers, reverse them, and drive in the blunt ends where the pointed ends have been. A little filing of the projecting points will then make them sharp and ready for business.

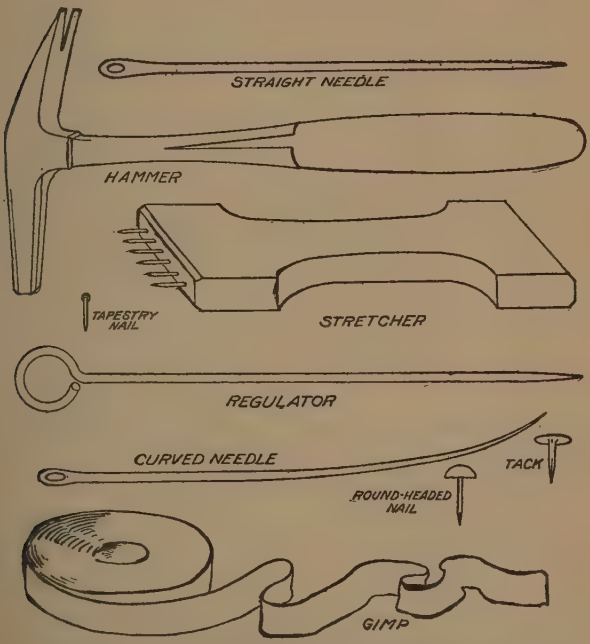


Fig. 85. Tools and Supplies Used in Upholstery Repairs at Home.

The straight needle should be 12 inches long; the curved needle, 6 inches long. Several other kinds will make the work easier. A straight, double-pointed 6-inch needle is convenient for sewing springs to webbing,

and triangular-pointed needles are best adapted to sewing leather.

Skewers are upholstery pins. They are usually 3 or 3½ inches long, with one end sharp and the other bent into an eye or ring, like the regulator. These tools are used in doing welt-edged work, or wherever it is necessary to hold goods temporarily while adjusting the work.

All of these articles may be purchased from any firm dealing in upholstery equipment. Most large mail-order houses have them, also.

Upholstering Materials embrace quite a variety of fabrics for coverings, also supporting fabrics and linings, stuffings, bindings, tacks and nails, springs and twine.

Webbing of the kinds known as L.M.C. and B. F.M. are the best kinds, the former being of a closer weave and a little better in some other respects than the latter. The average width used is 3½ inches. This material is often woven across the bottom of a framework and used as a support for springs.

Burlap is the best material to use over webbing, to reinforce its strength; and over springs, to keep them from cutting into lighter materials above. Burlap comes in three weights: light (8 oz.), medium (10 oz.), and heavy (12 oz.). The medium weight is best adapted for home use. This may cost 20 cents a yard, each yard running 40 inches wide Local dry-goods stores can usually supply used burlap, and their prices are often as low as 5 cents per yard. If you are careful in picking out good stock from these odd lots, you will find it just as serviceable as new burlap.

Stuffing Materials have quite a scope. The very best material available is curled horse hair. It is also the most expensive, costing as high as $1.50 per pound, depending on quality. The longer the hair, the better its resilient qualities. The stuffing recommended for most of our work, however, is tow. This can be purchased for about 5 cents a pound. It comes in three grades—fine, medium, and coarse. The fine variety should be used. Other stuffing materials are moss, kapok, alva, and excelsior. Cork shavings are generally used for boat cushions.

Wadding is a kind of stuffing arranged in sheets. It is used over other stuffing. Its function is to give a smooth, even appearance to the seat or cushion. Used over curled hair, it prevents the ends of the hair from penetrating the cover. It comes in sheets 30 x 36 inches and costs about 60 cents per dozen sheets.

Lining is not used at all in the cheaper grades of upholstery. In your work you will find it advantageous, for it gives the proper shape to the seat and permits better and smoother work on the final covering. Unbleached muslin is recommended, and this fabric is placed between the stuffing and the cover. After the application of the muslin, more stuffing may be added or the stuffing may be distributed by the regulator. Muslin 36 inches wide can be obtained for 10 cents a yard from any dry-goods store.

Under Coverings are some sort of fabrics tacked over the under side of the framework. Their purpose is twofold: to prevent dust from falling to the floor from the seat, and to exclude moths from the stuffing.

Cambric is desirable for this purpose. It comes in a 24-inch width and costs about 7 cents a yard.

Outside Coverings are represented by a variety of fabrics and materials, and good taste must be used in selecting the proper kinds for certain jobs. In many instances you will be able to make your repair and still utilize the old covering; where it is worn out, and the piece of furniture to which it belongs is a part of a suite whose upholstery is still sufficiently attractive to impel you to keep it, of course you will want to duplicate the discarded covering as nearly as possible.

In the selection of figured goods great discretion is necessary. The figures on fabrics for a chair back or seat should manifestly be smaller and more subdued than those for a larger piece of furniture such as a sofa or davenport.

There are three classes of coverings in upholstery. These are genuine leather, leather substitutes, and textiles.

Genuine Leather costs from 25 to 50 cents per square foot in the whole hide or full skin, and up to $1.00 per square foot when it is cut to order. It is tough while the natural oils last, but when these have evaporated through age, the leather becomes very brash.

Imitation Leather of the better grade will outwear some of the poorer and medium grades of leather. Moreover, these substitute leathers are much cheaper and resemble leather so closely that it takes an expert to tell the difference. They are manufactured in 50 and 54-inch widths, and cost from 60 cents to $1.75 per yard.

Textiles or Cloths are very durable, and are more pliable than either leather or imitation leather. These cost from $1.00 to $3.00 per yard in the general run of grades, but some of the finest of them will go as high as $25.00 per yard. A fair grade of tapestry will cost about $8.00 per yard.

Some of the more durable textiles are: tapestries, brocades, velvets, plushes, satins, and mohair. Cheaper textiles include velour, chintz, rep, and denim.

Binding or Edging is used for covering raw edges of the cover, also for hiding the common tacks which secure the cover to the framework. This material is called gimp, and comes in rolls of from 25 to 36 yards. Portions of a roll can be purchased from supply stores, even from the popular 5-and-10-cent stores. Black imitation leather gimp costs 20 cents a roll, and Spanish leather gimp costs 35 cents. Cloth gimp runs from 2 to 3 cents per yard.

Upholstering Nails can be had for about 2 cents a dozen. They are procurable in various finishes such as metalene, imitation leather, solid leather, and Spanish leather.

Upholstery Springs are provided in lengths of from 3 to 16 inches. They sell at 6 cents a pound. On this basis the cost of a large spring would be about 4 cents. The 9-inch springs are the ones most frequently used, and their price would be a trifle over 2 cents. It is better to purchase springs a little too long than a little too short, for it is easy to tie them down to the height desired. The rule is to have them twice as long as the width of the rail of the framework in which they are contained.

Twine is needed for tying down the springs, also for stitching edge work. Get No. 252 elm-flax stitching twine. This costs 40 cents per half-pound ball.

A Board-seat Footstool involves the simplest upholstering principles possible. This sort of footstool is the kind made by most of the boys who take manual training in the public schools, and there are to-day so many of such stools occupying favored positions in the home, the pride of every member of the family,

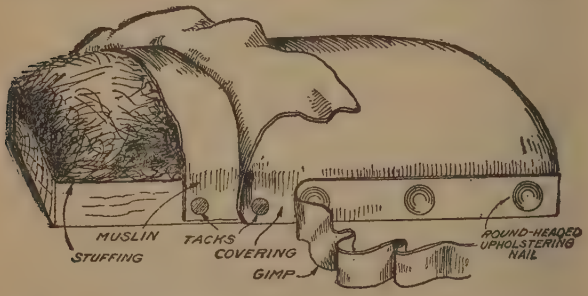


Fig. 86. The Materials Used in Upholstering a Board Seat.

that I may be excused for thinking that most of my readers, who lean to doing things themselves, will soon have a chance to gain a little practice in reconstructing Bobby's sagging cushion.

Fig. 86 shows a sectional view of the entire upholstery portion of this footstool, giving a good idea of the relative arrangement of parts. Whatever kind of stuffing is used, it should be gone over thoroughly with the fingers, pulling apart all the bunches and making an even, springy mass. Lay this matt of stuffing upon the footstool top. Over it place a piece

of muslin. Using 4-ounce tacks, fasten one doubled edge of the muslin, near its center, to the board, about ¼ inch from its lower edge. Stretching the muslin tautly over the stuffing, fold over the opposite edge and tack this down, also. Next, put one tack in the center at the end of the stool, and, stretching the muslin across to the other end, likewise tack this. Working toward the corners, gradually tack down both edges their full length, pulling the muslin taut as you go. The ends are finished last.

Use the regulator to even out any irregularities and to force the tow well out toward the outer edges of the muslin.

Place the cover over the muslin, and fasten this down in the same manner as the cloth, using, however, 2½-ounce tacks. These should be placed about 2½ inches apart. Do not forget to stretch the leather as tautly as possible during the tacking operation. Fold in the fullness of the cover at each corner, making a neat lap. Then trim off all leather edges to a uniform line about ¼ inch above the lower edge of the board.

Fasten the gimp at one corner by driving a round-headed upholstering nail about half-way in. Stretch the gimp toward the next nearest corner and place another nail. Set the dividers to 2 inches, and step off points from nail to nail. If the spacing does not come out uniformly, decrease or increase the divider setting, as required, until the spacing does come out right. Then prick holes through the gimp and into the board's edge, and drive in upholstering nails at these points.

When you have tacked down the gimp all around the edge of the top and have come to the place where

you started, withdraw the first nail, which you drove partly in, cut your gimp, give it a lap about the width of the nail's head, and drive the nail down through both pieces of gimp.

A Cart Seat can be upholstered in the same man-

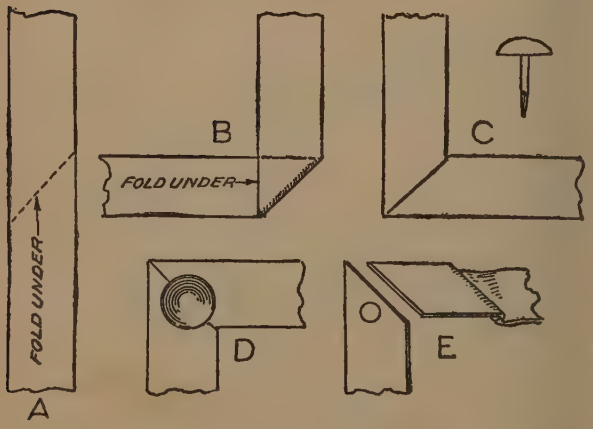


Fig. 87. The Method of Laying Gimp at the Corners.

ner as the footstool just described, except that the gimp will have to be run around on the top side of the seat instead of around its edge, and will, therefore, require somewhat different treatment in the turn. This method of gimping is shown very clearly in *Fig. 87*, the letters giving the successive steps.

A Chair Seat (*Fig. 88*) is not a difficult thing to repair or reupholster; in fact, the processes involved are very simple. First invert the chair, setting the seat upon the seat of another chair or a bench. It is then in a good working position.

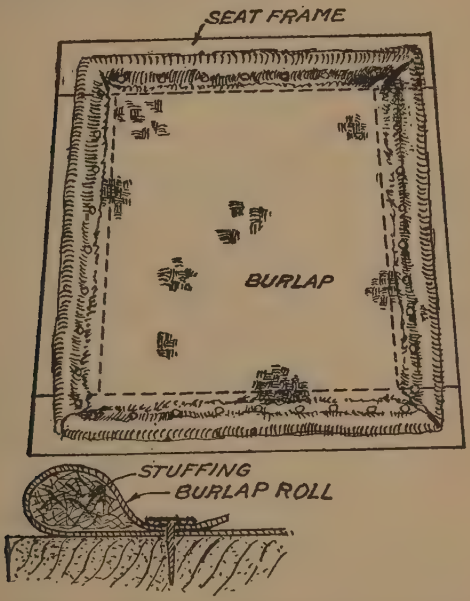


Fig. 88. Common Chair Seat and Burlap Covering.

Usually dining-chair seats are covered underneath with webbing. If you find any of this sagged, withdraw the tacks holding it, stretch it taut, and then tack it again. If the strands of webbing are so badly torn out that tacks will not hold in them, it is best to put in new strands. In doing this, lay the strands

across the opening in the seat, side by side, and fasten them with 10-ounce tacks. Then run strands the other way, weaving them under and over the first strands, and tack these.

Tack burlap over the webbing, using 4-ounce tacks. Cut the burlap slightly larger than the opening, and fold the edges over in tacking. Stretch the burlap

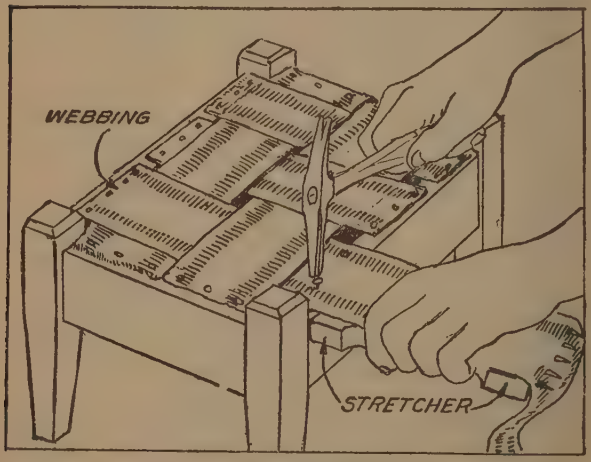


Fig. 89. Stretching and Retacking Webbing on a Footstool with Sagging Seat.

slightly, but not enough to prevent it touching the webbing under weight of a sitter's body; for the burlap itself is intended to receive most of this burden.

Place the stuffing in position. Over this secure a sheet of muslin, and then lay a sheet or two of blue-sheet wadding over all. Follow with the leather or tapestry cover, and retack the gimp in the rabbet provided for it.

A Framed Structure, such as a footstool (*Fig. 89*) having rails, or a chair possessed of rails, is upholstered in a little different manner. Generally webbing is used to cover the opening, and this is done on the upper side. To stretch the webbing as tautly as possible, use the webbing stretcher shown in *Figs. 85* and *89*. In this operation the points in the end of the stretcher are pushed through the webbing while the rounded end of the tool acts as a fulcrum against the rail of the furniture. Fasten down the webbing strands with five tacks, cut off the fabric 1 inch longer, fold this end over the tacked portion and confine it with several tacks.

Cover the webbing with burlap. The edges should project somewhat beyond the webbing, and are rolled over a filling of tow or other stuffing material. (See *Fig. 88*.) These rolls are then tacked down. The remaining operations are similar to those described previously under the heading, "A Board-seat Footstool."

A Hard-edge Seat is the kind of seat that is made up of a box-like frame whose interior contains a series of springs and whose edge needs to be stuffed and sewed in a way to make it hard and firm. Sometimes the springs set on wood or metal slats, and sometimes they rest upon webbing. They must be securely fastened at the bottom in order to keep them in place at that point, and also must be relatively confined at the top with something flexible, like twine, so that they will be free to contract and expand, but prevented from lopping over sidewise.

It is really the sagging of the springs which causes most of the upholstery troubles in the average home.

The twine slips or breaks, allowing the springs to get out of position, the stuffing is robbed of its support, an undue strain is put upon certain portions of the under and outer coverings, and the result is a broke[illegible]down piece of upholstery.

For these reasons, where a seat of the spring variety

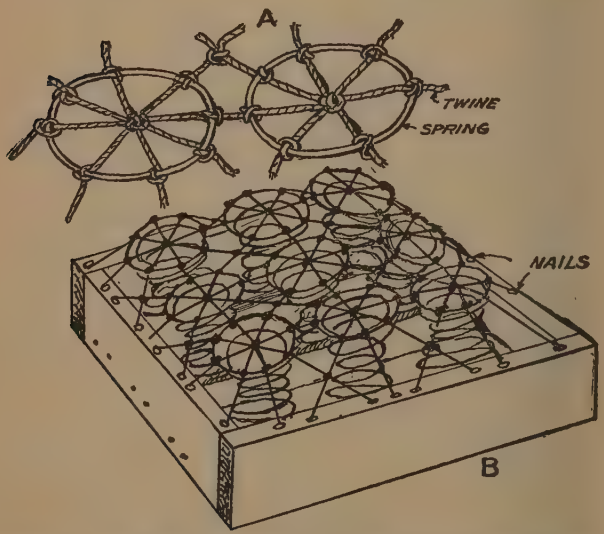


Fig. 90. Box-edge Chair Seat and Method of Tying Down Springs.

begins to get bumpy, or the leather or tapestry to tear out, the best thing to do is to remove immediately the cambric underneath and make an inspection of the spring tyings. If any of these are broken or out of place, it is an easy matter to repair them. If, on the other hand, the stuffing has become disarranged, or the

leather torn, the latter should be removed and the proper steps taken to remedy the trouble.

A Box-seat Construction, with springs in proper positi is shown in *Fig. 90,* also a detail of the type of tying-down usually applied to the upper coils. In a seat of this kind, the springs are sewed down at the bottom, if webbing is employed, and, when other forms of support are used, are wired or stapled. In fastening down the tops it is best to have at least eight points of connection in each coil, the points nearest the frame being connected directly to it by the strands, which are secured with two heavy tacks. The interior points communicate with one another by short strands that do not go to the seat. The seat strands are pulled taut enough to bring the springs down sufficiently to make a good form to the spring tops as a whole.

Tack a piece of 10- or 12-ounce burlap on the top edge of the frame, using 4-ounce tacks, folding the edges over before tacking. In doing this, do not pull down the springs.

When putting in new stuffing, lay on enough of this to allow about 3 inches of the mass to extend over all sides of the seat.

Place a piece of light burlap, 6- or 8-ounce, over the stuffing, and let it come over the frame edges far enough to be slip-tacked.

Then form the rolled edge, as in *Fig. 91.* This is done by gathering up the projecting stuffing into a roll and sewing it in the burlap margin, running the needle through the stuffing while so doing. This row of stitching should come just outside the edge of the springs. Each stitch should be about 3 inches long.

After all four sides have been stitched, pull the twine taut by beginning at the first stitch and drawing up on each one. Finally, take a few stitches through the center of the seat at irregular intervals, thus confining the stuffing into a smaller compass and solidifying it. Be careful not to stitch around the loose coils of the springs.

Release the slip-tacking and roll the loose edges of the burlap under the stuffing. Drive tacks through that

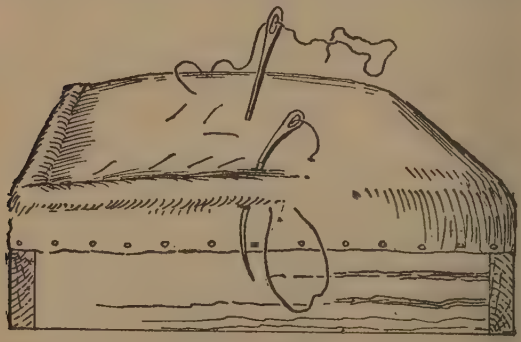


Fig. 91. Forming the Rolled Edge.

part of the burlap which comes in contact with the top edge of the frame, beginning at the center and working toward all four corners. Use care to make all sides equal. Tack the corners last. Should they be too full, due to the overlapping of the burlap, cut away some burlap and remove the necessary amount of stuffing needed to keep the corners even with the sides.

The stitching of the rolled edge already roughly shaped is accomplished by going around with two or three rows of stitching. Use a 6-inch curved needle.

Begin at the left-hand end of one of the rolls, and start the needle about 1½ inches from the row of tacks, allowing it to emerge about 1½ inches from the row of stitching. About 1½ inches to the right, insert the needle again into the roll, ¾ inch from the stitching, and allow it to emerge about ¾ inch from the tacks. Tie this end of the twine around the other end with a

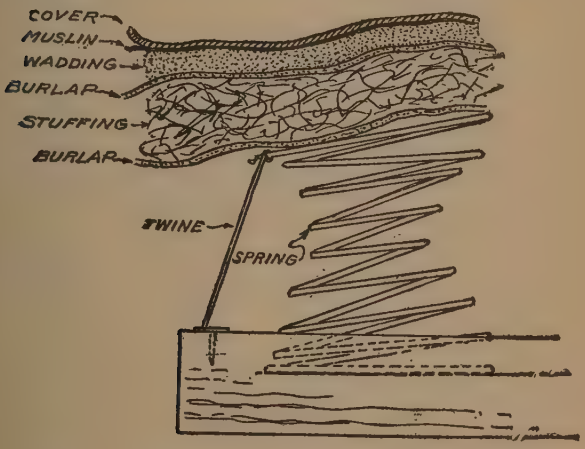


Fig. 92. A Sectional View of Hard-edge Seat Upholstery.

double slipknot. Insert the needle again about 1½ inches to the right, then up through the roll, then down, as before. Repeat this operation around all four sides of the seat, regulating the stuffing as the stitching progresses. Always insert the needle at a right-angle to the roll, for the arc of the needle gathers in considerable stuffing which is forced into the roll as the twine is pulled taut.

The stitches in the second row are not made in a zigzag manner as in the first row. The needle is inserted ½ inch above the first row and allowed to emerge at the same distance on top. Work to the left, at a space of ¾ inch, and use the double slipknot, as previously. Pass the needle to the right about 2½ inches, and insert it as at first; then carry it back again about ¾ inch and push it through the roll, allowing

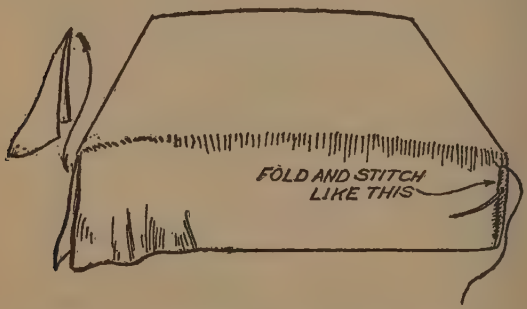


Fig. 93. Forming the Corners of the Covering.

the end to project; then loop the twine around the point. Repeat on all four sides.

After the second row of stitching, a third row may be made. Then place more stuffing on top of the seat, rounding out all unevenness. This is called double-stuffing. Hair is extremely resilient, and if you have not used it for the lower portion, you are advised to do so for this upper section.

Place a layer of cotton batting or wadding over this. Over the latter stretch a piece of muslin. Keep the muslin smooth, especially at the corners, cutting away all surplus material.

Lastly, the cover is put on. Tack it under the lower edges of the frame, and after cutting a gore out of each corner, as in *Fig. 93*, fold the corners under and fasten with a blind-stitch, using the curved needle.

Chair Backs can be reupholstered by following the directions already given for a board-seat footstool or a dining-room chair seat. The webbing or burlap is tacked to the edges of the opening in the chair back, and the rest of the work is carried on as in the other cases, gimp and round-headed nails finishing the job. Stitch the stuffing to the burlap, for the best results.

Chair Arms can be reupholstered by tacking twine over the edges, forming loops into which the stuffing is placed. The twine holds the stuffing in place while the muslin is being tacked on and the proper shape given to the arm. The cover is put directly over the muslin, trimmed, and then the gimp is applied.

Davenports get a good deal of use, as a rule, and require frequent inspection and occasional repairs to the upholstery. They should be pulled out, the cushions removed, likewise the cambric below and the muslin above, and any defective parts replaced or repaired. Rips should be kept sewed, sagging springs braced up, and additional stuffing added when the old gets lifeless or flat.

Automobile Cushions and Buggy Cushions can also be kept in good repair by studying the general principles of upholstery as laid down in this chapter.

IX

METAL-WORKING

METAL is a material coming more and more into use about the home, as our forests thin out and lumber goes higher in price and lower in quality. For this reason, the home-saver should understand the fundamentals of metal-working in so far as they affect the repairs and new installations he wishes to make in the household and upon the premises.

In Chapter I is given a list of tools for taking care of the wood-working needs of the average home. In the present chapter it is my purpose to suggest an outfit of metal-working tools and to tell you how to get the best use out of them when emergency fix-ups are required.

Metal-working Tools that can be found in a wood-working outfit, such as given in Chapter I, are as follows:

Bench, vise, grinding wheel, hammer, brace, hand drill, bit-stock drills, saw file, screwdriver, try-square, scratch-awl, oilstone, cutting pliers, oilcan, quilting clamps.

If you have these, you do not need to duplicate them in selecting an outfit of tools for working in metal.

A Metal-working Outfit of Tools might include, in addition to the tools common to both metalwork and woodwork, the following:

1 small metal vise,
1 pair tinner's snips,
1 monkey wrench,
1 pipe wrench,
1 hacksaw frame and blades,
1 centerpunch,
1 coldchisel,
1 blowtorch,
1 mill file,
1 round file,
1 each, bitstock drills, 1/4, 5/16, 3/8 inch,
1 old flatiron (anvil),
1 medium diestock,
1 each, dies, 3/16, 1/4, 5/16, 3/8 inch,
1 each, taps to match above.

These tools ought to be purchased for about $10.00. The flatiron, fastened in the wood vise, flat side up, makes a very excellent anvil. On it nails and wire can be straightened, over it wire can be bent, and it also makes a first-class foundation for rivetting.

A number of the special tools mentioned in the foregoing list are illustrated in *Fig. 94*. The others named will be found in subsequent illustrations in this chapter.

To Sever Light Sheet Metal with snips, hold the snips in the one hand while the metal is supported in the other—as you would cut paper with ordinary household scissors.

To Sever Heavy Sheet Metal with snips, set the snips upon the bench or table, as in *Fig. 95*, and using the full force of the arm and shoulder for compressing the free handle, do all of the cutting well back in the throat of the snips. The other hand is used to support the metal, except in cases where the strip may resist the power of one arm, whereupon the second arm is put into coöperation by placing the palm over the hand gripping the snips.

To Sever Metal with a File, it is necessary to file grooves, of as great a depth as convenient, around the material, and then break off the piece by bending

it back and forth. The best type of file for this purpose is a saw file, such as shown in *Fig. 96*, but any

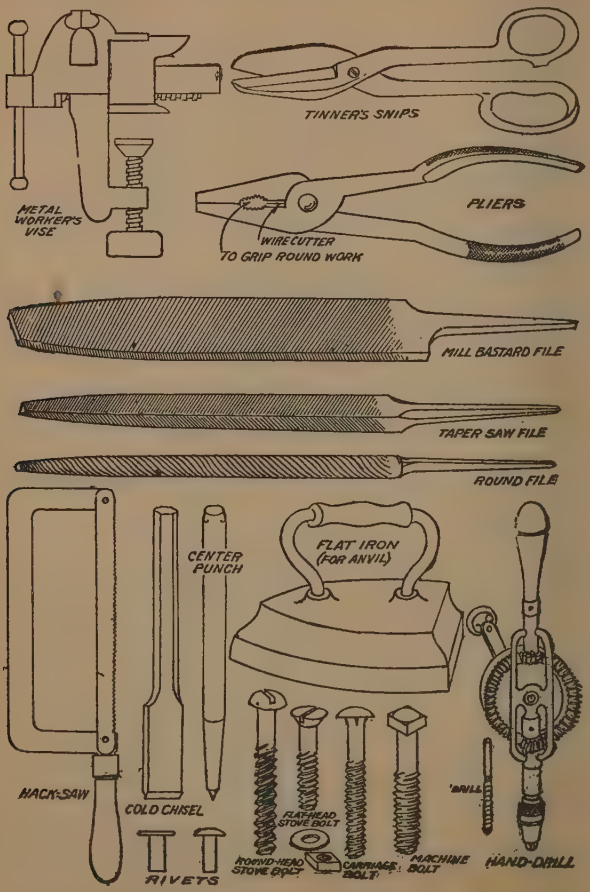


Fig. 94. Metal-working Tools for the Home Workshop.

sharp mill file can be used. In this fashion it is possible to sever wire, rod, tubing, and narrow strips of sheet metal.

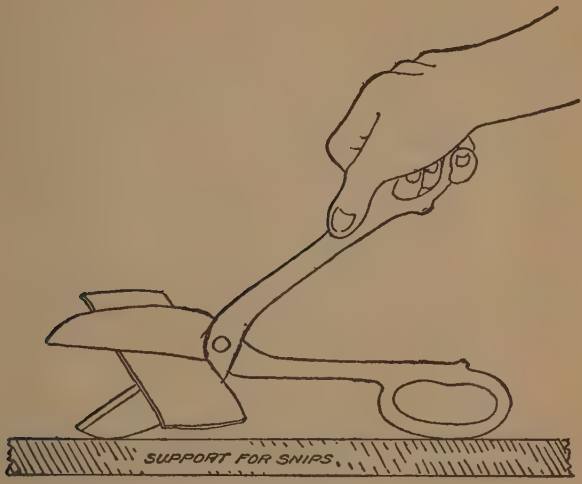


Fig. 95. Cutting Heavy Sheet Metal with Snips.

To Sever Metal with a Coldchisel, if possible lay the material upon a block of lead, as an anvil, although the bottom of an old flatiron will do very well if care is taken not to force the coldchisel through the metal into the anvil, which would soon dull the tool. The lead prevents dulling, because of its comparative softness, yet it is hard enough to keep the material from sinking into it from the impulse of the blow.

Hold the coldchisel upright, as shown in *Fig. 97*, and strike a quick, decisive series of blows, moving the tool across the surface as fast as a blow is given. Re-

peat the trip back and forth until a good depth of cut has been formed along one side of the piece; then turn it over, square a line across the new surface, directly above the cut line, and make another incised line to a good depth.

If the metal cannot be entirely severed with the cold-chisel, break it by bending it back and forth in the hands or over the edge of the bench. If it is too thick

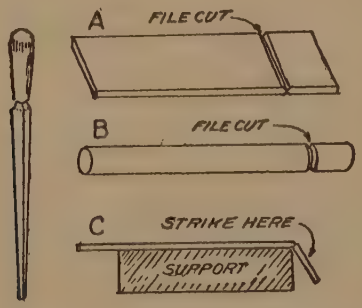


Fig. 96. Severing Metal with a File.

to bend readily by muscular strength, lay it over the anvil, as at *C, Fig. 96,* and sharply strike the projecting portion with a hammer; then turn the under side up, and bend the piece the opposite way, continuing the method until the desired strip drops off.

To Sever Metal with a Hacksaw, you must have the proper kind of teeth in your blade, must have the blade tight and well oiled, and must have the cant of the teeth turned away from you. (See *Fig. 98.*)

Very fine teeth are required for sawing thin sheet metal and tubing, a medium tooth for sheet metal and

tubing of moderate thickness, and a coarse tooth for metal of heavy stock.

Be careful not to kink or bend the saw blade, as it will then either break or will pinch and refuse to guide well.

To Bend Sheet Metal of very thin gauge, pliers

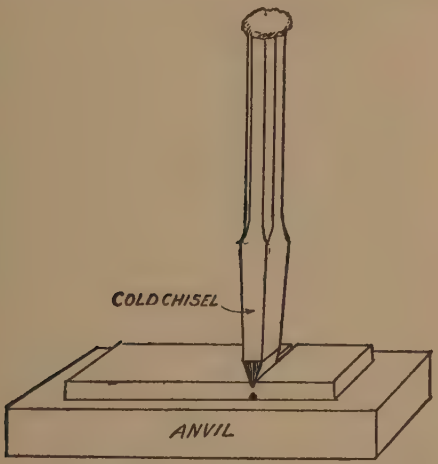


Fig. 97. Severing Metal with a Coldchisel.

can be used if the material is not very wide. If too wide for pliers, lay the piece over an anvil, or other desirable former held in the vise, and strike it with a mallet or hammer. Or clamp the stock in the vise and bend it from that position. If the stock is too stiff to handle in any one of these ways, and a sharp bend is desired, file a shallow groove on the under side, and then bend. If the stock is of too heavy a gauge to be bent cold in any way, you will have to make it

red-hot in the furnace or stove, lay it quickly over an anvil or other kind of former, and strike it swiftly until it has assumed the desired angle or curve.

To Bend Wire (*Fig. 99*) various tools and processes can be used, according to the stiffness of the wire and the form desired. Some wire is so thin and soft it can be readily formed in the fingers; heavier wire will call for the use of pliers; still heavier wire, for hand or plier manipulation in the beginning, with

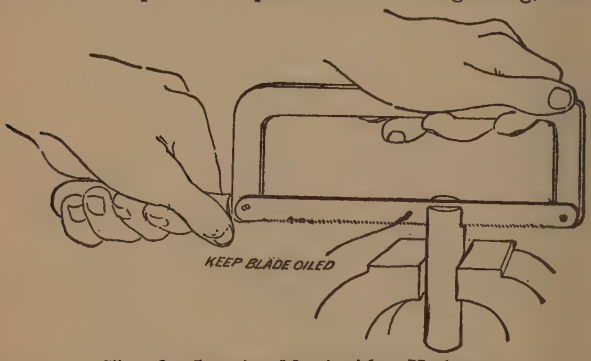


Fig. 98. Severing Metal with a Hacksaw.

a finish made with a hammer over some sort of a former.

Very often the householder finds it necessary to make an eye or ring in the end of a piece of wire. (See *A, B, C.*) As a rule, all of this work can be done with the pliers, the long-nose type being preferable, but if the wire is exceptionally stiff it may have to be hammered around a rod used as a former.

To Bend Rod, not smaller than ¼ inch, use the vise, or the vise and a former; or heat the rod to a cherry-red and bend it in that condition.

To Bend Tubing is often a delicate task, for most tubing will kink if bent to any great extent. For slight bends, fasten the stock in the vise and use the hands for a leverage. If the material is too stiff for this,

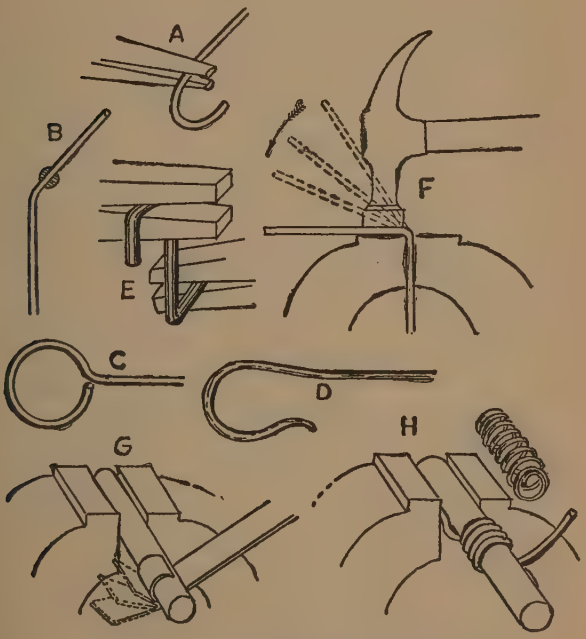


Fig. 99. Different Ways to Bend Metal.

force it over by laying a padded block against the projecting end, then strike with a mallet or hammer. If the bend must be quite sharp, plug up one end of the tubing, fill the hollow with resin, hold the tubing over a gas blaze until the resin is melted, and then

bend in a vise. When the tubing is bent, hold it once more over the gas blaze and let the molten resin escape into a vessel of some kind.

Piercing Sheet Metal (*Fig. 100*) is the easiest and quickest way in which to put a hole through it, and

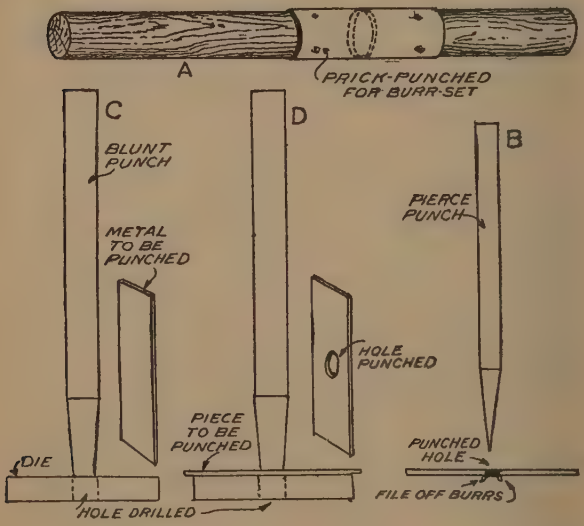


Fig. 100. Punching Thin Metal.

the hole is usually used for admitting a tack, nail, rivet, or screw. Inasmuch as such holes must be forced through by sheer strength of the blow, it is plain that it is not practicable to make a very large hole or to put any hole at all through thick metal.

Piercing punches can be purchased, but it is very easy to form one out of home materials.

To Make a Piercing Punch, sharpen the tang end of an old saw file. Do not have the point too slender, or it will dull easily.

When piercing, hold the punch upright and strike a sharp blow with a hammer. The work should rest upon a hardwood block. The punch will force out ragged burrs of metal on the under side, which should be filed off.

To Burr-set a Piece of Tubing, such as the ferrule upon the joining ends of a fishing-rod, merely punch the metal burrs into the wood within the ferrule. This will hold it very securely. (See *A* and *B, Fig. 100.*)

To Punch Sheet Metal is a process very similar to piercing, except that the punching is done by an instrument with a blunt end. But no one could force a blunt end through metal in the same manner as a sharp point. For this reason, when large holes are wanted in thin metal, a metal block is substituted for the hardwood anvil, and this support contains a hole of the size desired in the work. The punch is tapered to fit the opening.

To Make a Blunt Punch, take a broken auger bit of small size, or any good piece of round steel, and grind one end to a long taper, with the flat end the size you want your hole.

To Make a Punching Die, as the metal block is called, drill a hole in almost any piece of scrap metal.

In punching a hole with these tools (*C* and *D, Fig. 100*), place the piece of sheet metal on the punching die, with the punch held directly above the hole in the die, and strike a very hard, sharp blow—hard enough so that the punch will be immediately forced through

the metal and into the die hole, thus shearing off the core of the new hole. If the punch and die hole are not in alignment, a poorly punched hole will be the result, else no hole at all.

To Punch a Flat Spring, such as a broken clock spring, it is first necessary to draw the temper at the end where the hole is to occur. "Drawing the temper" is to make the metal softer. To do this, insert the end of the spring in a gas blaze. Watch it carefully. As soon as it has turned to a dark blue color, withdraw the spring and let it cool in the air. It can then be punched in the ordinary manner, using a die.

Broken clock springs of this kind will often furnish valuable small repair springs for other household devices.

To Make a Coil Spring—another form of repair spring frequently needed around the household—buy some spring wire, either steel or brass, as desired, at a hardware store. Fasten one end of the wire in the vise, against a rod of slightly less diameter than the inside diameter of the desired spring. (See *H, Fig. 99.*) With the hands, coil the wire closely about the rod former until the spring is of the required length. Cut off the surplus wire, and the coil spring is done.

Drilling Metal is not as fast a process as boring wood, but, providing the drill is properly sharpened and the drilling done in the right way, it does not require as much exertion to make a hole in metal as you might suppose. Chapter II gives the method of sharpening a drill.

To Drill a Small Hole, say up to ¼ inch diameter, locate the hole position and mark this by striking a

good blow upon a centerpunch. (See *A, Fig. 101.*) The centerpunch hole keeps the bit from running out of place during the process of starting to drill.

The drilling can be done horizontally or vertically in a vise. If the metal should be quite thin it will be best to lay it flat upon a block, to one edge of which has been nailed a ledge to keep the metal from rotating,

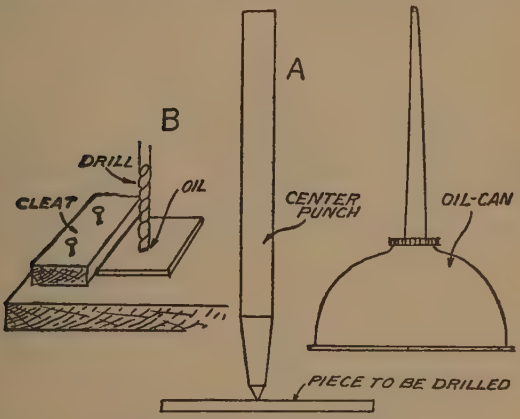


Fig. 101. How to Drill Metal.

as at *B, Fig. 101.* In either case, apply a few drops of kerosene oil to the drill for all drilling except that in cast metals, which should be bored dry. Exert as much pressure as possible upon the brace or hand drill, as force speeds up the work. When the drill point goes through, a burr will be left. This should be filed off.

To Drill a Large Hole—say from ¼ up to 1 inch diameter—it will be better to use two or more sizes of drills; it is very difficult to make directly, for in-

stance, a ⅜-inch hole, and a 1-inch hole bored that way is simply out of the question.

Reaming is the process of enlarging a hole. This can be done by using a larger drill in the smaller, or by filing with a rat-tail file.

Counter-boring is a method of boring whereby the shoulder or head of a bolt or screw can be let down below the surface of the piece of metal through which the threaded portion passes. To counter-bore

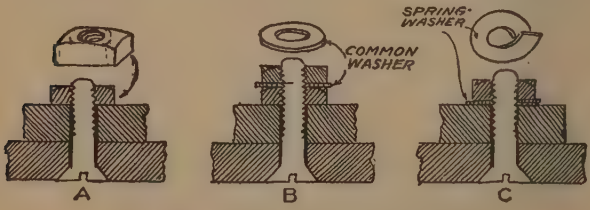


Fig. 102. Three Ways to Apply Bolts.

in metal, first drill the hole to admit the threaded portion of the screw, then drill another and larger hole around the first one, to the depth required.

Countersinking (*Fig. 102*) is the process of giving a tapered enlargement to the outside of a screw hole, so that the beveled head of a screw will not project. This work can be done with a drill several sizes larger than the drill used in boring the shank hole.

Joining Metal Parts can be done in several ways. One method is to use bolts and nuts. Another way is to rivet. A third process is to use screws. Another scheme is to solder. I will herein take up all these methods except that of soldering, which will be found fully treated in Chapter X.

To Join with Bolts and Nuts, make holes the size of the threaded portion through all pieces to be connected. Countersink if required, as at *A, Fig. 102.* Apply a nut to the threaded end of the projecting bolt, as shown.

If the nut has a tendency to work loose, as where the bolt is subjected to a great deal of vibration, it may be fastened in two ways. These methods of locking are shown at *B* and *C, Fig. 102.* The *B* way is to use a second nut over a washer laid upon the first

Fig. 103. How to Do Rivetting.

nut, which produces a jamming effect upon the under nut. The *C* way calls for but one washer and one nut, but this washer must be of the spring type.

To Join by Rivets (*Fig. 103*), drill through all pieces to be assembled, using a drill to match the diameter of the rivets. Insert the rivet through the holes made to receive it, and set the rivet head upon a vise, anvil or other hard support. Use a regular rivetting hammer if you have one; if not, use an ordinary household hammer. Strike the projecting end of the rivet slantingly, in such a way as to batter it down. Round it over rather than make it flat, for a flattened head is more likely to break off under strain.

If the hole is a little too large to make the head safe, insert a close-fitting washer between, then proceed to rivet.

Rivets can be secured at a hardware store in various metals, such as iron, brass, and copper, and there are different sizes as well. They are quite inexpensive.

Home-made Rivets can be produced by sawing off the heads of wire nails and round-headed screws. Heavy wire and small rod will also furnish excellent material for rivet-making.

A Stovepipe Lap Joint (*Fig. 104*) is a very common method of joining the meeting edges of any thin

Fig. 104. A Common Joint Found in Sheet Metal Construction.

cylindrical object. For use with tin and thin brass it is a very good joint indeed. It consists of bending back both meeting edges of the cylinder, giving them a hook together, then hammering down the folds to a close union.

Taps and Dies, for forming screws and nuts and threaded sockets, are a very useful adjunct to the home-owner's tool kit. A few of the most needed sizes will not cost much and they can be secured at hardwares and at most 5-and-10-cent stores. The dies are for forming threads upon a bolt, while the taps are for making threads in a hole which is to receive the threaded bolt or screw.

In selecting these, be careful to see that the diameter of the tap and die correspond, also the numbers of threads to the inch; in other words, a die marked

"5/16—20" means that it is of 5/16 inch diameter and has 20 threads to every inch of its length, and the tap to match it will have equivalent markings.

You will also need a tap wrench and die wrench for operating the set properly. These are not expensive.

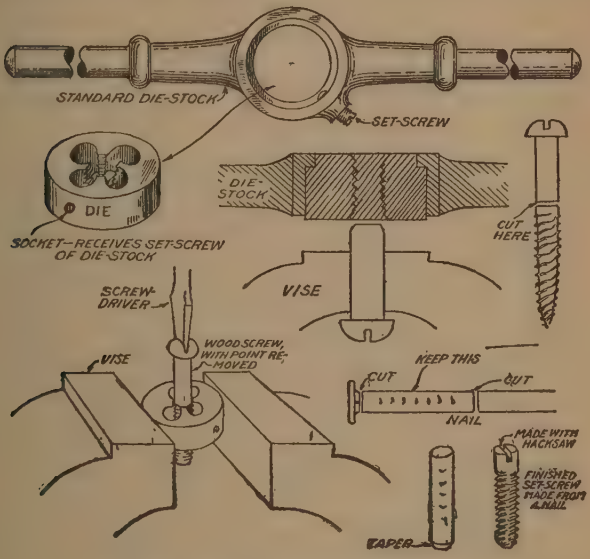


Fig. 105. How to Make Machine Screws.

Figs. 105 and *106* show the tools mentioned, also some of the chief methods used in handling dies and taps.

Metal Screws, suitable for use with your set, can often be secured from the home junk-box, from the children's discarded toys, from old batteries, from dealers in machinists' supplies, radio apparatus, automobile equipment, *et cetera.*

Home-made Metal Screws can be formed out of wire nails, wood screws, heavy wire, and brass and iron rod. Of these, the wood screws are the most convenient, for all you have to do is to saw off the threaded portion of a round-headed screw (see *Fig. 105*), then form threads on its shank by using a die. With the wire, nails, and rod, the screw will have to be of the setscrew pattern—headless so far as projecting rim goes—the slot being made with a hacksaw.

Always provide yourself with a screw before attempting to make a tapped hole for such a screw. Moreover, do not drill the hole for the tap until you have first tried to make a tapped hole in a piece of scrap metal.

To Make a Tapped Hole, choose a drill of a diameter to compare with the size of the core or solid portion of the tap. Drill as for any hole. Fit the tap in a tap wrench, if you have one; if you do not have one, use pliers or a light monkey wrench. Set the tap in the hole in an upright position, oil it well, then revolve it to the right, using considerable pressure. Do not bear heavier on one side than the other, else the tap may break. If you feel the tap sticking, back it up a trifle and go ahead until it sticks again, adding a little oil at each one of these actions. (See *Fig. 106.*)

As a rule the work should be held in the vise and the tap revolved in the manner stated; but with thin metal the process can be reversed; that is, you can fasten the tap in the vise, take the metal in your hands and revolve it.

Metal Stock for Home Use can usually be obtained from large hardware stores in your home town,

from a blacksmith, or from a steamfitter. Mail-order houses in the big cities also carry such materials and make prompt shipments.

Fig. 107 shows common types of such stock, which

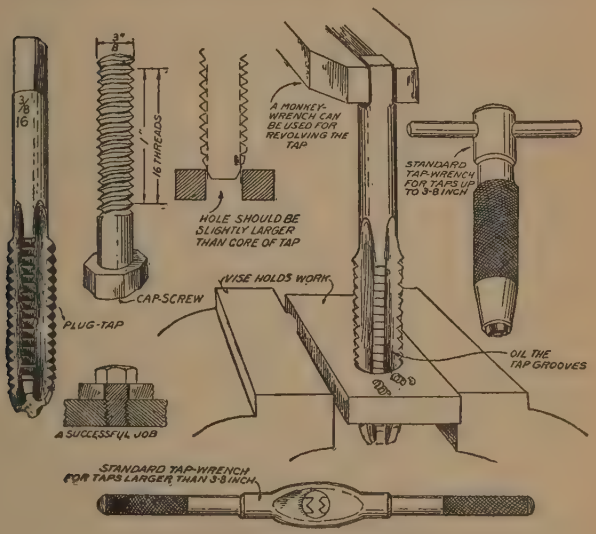

3/8
16
16 THREADS
A MONKEY-WRENCH CAN BE USED FOR REVOLVING THE TAP
STANDARD TAP-WRENCH FOR TAPS UP TO 3-8 INCH
HOLE SHOULD BE SLIGHTLY LARGER THAN CORE OF TAP
VISE HOLDS WORK
CAP-SCREW
PLUG-TAP
OIL THE TAP GROOVES
A SUCCESSFUL JOB
STANDARD TAP-WRENCH FOR TAPS LARGER THAN 3-8 INCH

Fig. 106. How to Tap a Hole.

is sold by weight. You can get, in sheet metals, tin, iron, galvanized iron, steel, brass, copper, and aluminum. Bandiron comes in standard widths and thicknesses.

Information about pipe will be found in Chapters XVII and XVIII.

Melting Lead is an easy thing to do at home, and there are numerous occasions when a little knowledge of lead work will prove advantageous. Old pieces of

lead plumbing pipe can be secured from a local plumber and will provide an abundance of material. A simple ladle can be fashioned from a tin cup, or even from the cover of a coffee can, by bending a pouring lip with a pair of pliers.

Lead melts at a comparatively low heat, and almost any gas-stove flame or heating-stove fire will do for the purpose. As soon as the metal has become molten,

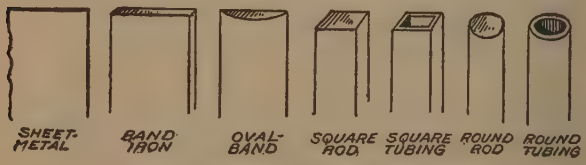


Fig. 107. Metal Stock for Home Use.

the ladle should be immediately transferred to the mold and the hot liquid poured in. When the metal has cooled the forms can be removed.

Molds that will do many satisfactory home jobs can be made from two wooden blocks by hollowing them out to the form desired, then temporarily fastening them together with nails, screws, or twine. In this way, lost anchors for toy sailboats can be replaced, fishsinkers can be made, and many other uses will be found for the art.

X

SOLDERING REPAIRS

Of the mechanical jobs to be done about the home or farm, soldering is one of the most frequently called into play. It is really a very simple process, yet one that is often unsuccessfully applied because of the ignorance of some home-owners about its fundamentals.

The Process of Soldering consists in joining together pieces of metal by means of another metal which will melt at a lower heating point than the principals. This is done by raising the temperature of all parts to the melting point of the solder by means of an instrument called a soldering copper or soldering iron, although a flame can be applied directly, as from a gasoline blowtorch.

The Soldering Copper (*Fig. 108*) for repair work about the household should weigh about 1¼ pounds. First-class work cannot be done with a lighter copper than 1 pound, as it is too small to hold its heat a reasonable length of time.

Tinning the Soldering Copper is a very important part of the work. No successful job can be done with a copper that is not well-tinned, a fact which accounts for probably four-fifths of the bungling soldering jobs performed by amateur workmen.

New coppers are not tinned; it is up to the purchaser to do this himself—and to keep his copper that way. To tin the copper, heat it until it will melt

solder the moment they touch. Only practice will tell you when this degree has been reached, but bear in mind that it will be before the copper gets red hot, which is a temperature too high for the good of any

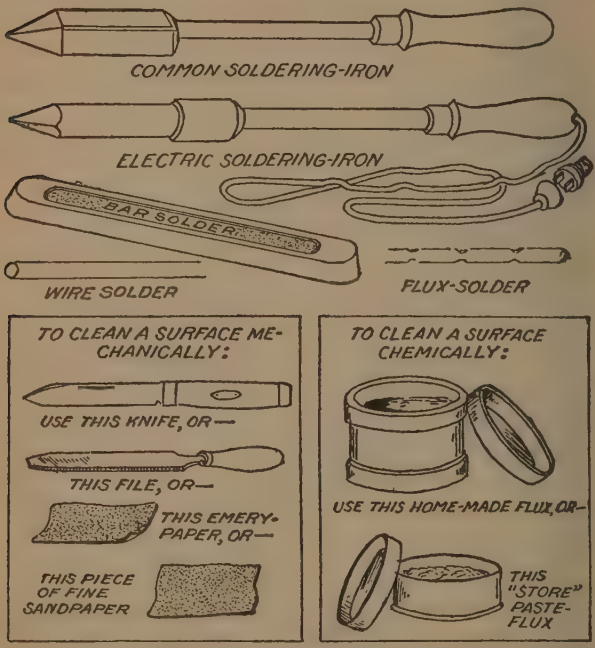


Fig. 108. Tools and Supplies for Soldering.

tool of this kind. Some experts judge the temperature very unerringly by holding their hand about three inches from the copper, as in *Fig. 109;* others tell by holding the tool close to their cheek.

When the copper is thus heated, place it in a vise

MOTHER SOLDERS UP A HOLE IN THE BOTTOM OF HER OLD DISH PAN, MAKING IT AS GOOD AS NEW

and file all four sides of the tapered portion very clean with a coarse file.

Following this, reheat the copper as before; then rub the tip sides on a block of sal-ammoniac. Next, touch the tip to a bar of solder. Repeat the process until the tip is well tinned with the solder. The tin-

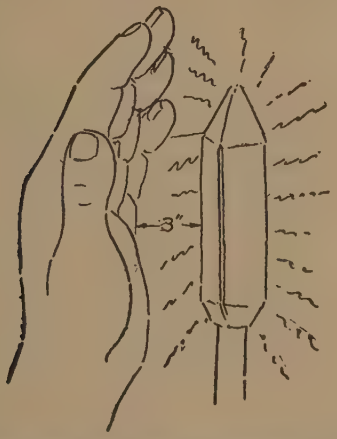


Fig. 109. How to Test the Correct Temperature for a Soldering Copper.

ning should run back about ½ inch from the point. Resin can be used in place of the sal-ammoniac by pulverizing a small quantity and placing it on a piece of clean tin, then melting some solder in the resin, and rubbing the point of the copper in the mixture.

Heating the Soldering Copper in a dirty flame will never do. All heating should be done over a clean flame, such as that of a forge, a gasoline-, gas- (*Fig. 110*) or kerosene-burner, or over the live coals

of a stove or furnace. A one-quart blowtorch (*Fig. 111*) is the finest heating device, and the cost is not very great considering the value it renders in this and in other ways about the ordinary home. As stated previously, a soldering copper should never be made red-hot, as such a temperature will destroy the tinning and demand more treatment to replace it.

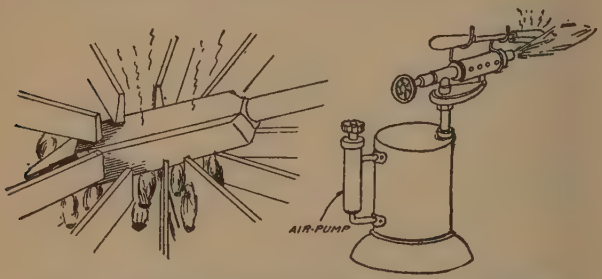


Fig. 110. Heating a Soldering Copper on a Gas-burner.
Fig. 111. Heating a Soldering Copper with a Gasoline Blowtorch.

Upon removing the copper from the fire, always wipe it off on a piece of dampened cloth. This removes any possible foreign matter, such as soot, which may have collected during the heating process.

Flux is a substance used in cleaning the metal so that the solder will grip. When a metal is exposed to the air, especially when heated, a coating of oxide forms on the surface, and this must be removed. Chloride of zinc, resin, soldering paste, and soldering salts, are all commonly used forms of flux. Of these, chloride of zinc is the favorite all-around flux. It can be successfully used on any of the soldering metals except aluminum, which requires a special preparation.

However, chloride of zinc is not to be recommended for electrical work, where you should use resin. Resin is often used as a flux in hollow-wire solder, in which it is put into small pockets by the manufacturer.

Chloride of zinc can be purchased at a drug store, but the better way is to make it yourself. Procure a 4-ounce bottle of muriatic acid at the drug store. Place this in an open glass dish and into it drop small pieces of zinc, which you can cut from the outside of an old dry-cell, from a fruit can cover, or which may be obtained at a tin shop. The insertion of the zinc scraps will cause the acid to boil violently, but keep adding zinc until all action has ceased. Then add ¼ part of water (by volume), and strain the mixture through a piece of cheese cloth into a bottle. Keep the solution air-tight by using a glass stopper or rubber cork.

Solder, for ordinary repair work, should be what is known as "fifty-fifty." This means that it is composed of 50 per cent. tin and 50 per cent. lead. For very particular work, requiring great strength, a solder composed of 60 per cent. tin and 40 per cent. lead should be used.

Solder comes in the form of bars, solid wire, resin-core wire and acid-core wire. The cored wires, as stated before, are self-fluxing, containing pockets of cleaning compound which is distributed upon the metal as the solder is melted. They do not, as a rule, work as well as the solid solder type of wire.

Preliminary Cleaning of the metals to be soldered must be done, if they are very dirty, before applying the flux. All paint, scale, oxide, and grease should be removed by scraping with a knife, by filing, or by

abrasion from emery cloth or sandpaper. Hot lye water and gasoline will usually remove grease and dirt. A pointed hardwood stick will assist materially in removing the bulk of hardened grease from a seam or corner.

Six Rules for Good Results in Soldering are as follows:

1. Have a well-tinned soldering copper.
2. Have the metals thoroughly cleaned.
3. Make the copper hot enough to melt solder instantly.
4. Have a good flux within reach.
5. Keep the copper on the metals until they are as hot as the flowing solder.
6. Spread the solder thoroughly and neatly.

General Hints on Soldering are contained in the following paragraphs:

The tinning of the soldering copper is for the purpose of bringing the copper to a condition whereby it will pick up globules of solder from the bar or wire and transport them to the seat of work without losing them. Solder, therefore, is not applied by holding the bar above the metals and allowing the molten particles to drop on the spot to be soldered, but by carrying such particles on the copper itself to the piece of work.

Do not "pile up" the solder. Solder is of service only when forming a bond between two parts. Hence, use no more than necessary to make a strong joint.

No sharp points or rough edges should be left on the finished work. Smooth any such parts with the hot copper, flowing them down into a good-looking flatness.

If the soldering copper should not be hot enough, the joint will be weak and the job rough.

If you burn off the tinning on your copper by getting it red-hot, the tool will not pick up solder again until you have gone through the process of filing and retinning it.

When soldering zinc, the soldering copper must not be too hot or it will burn or melt the zinc.

When soldering copper or steel, a very hot copper is needed.

When soldering galvanized iron, the zinc coating must first be removed, if a strong job is desired.

Apply the flux with a stick or a swab, and keep the flux covered when not in use.

When soldering gasoline or kerosene tanks, keep all open flames away. Therefore, do not use a blowtorch, but apply the soldering copper. Rinsing out an empty tank with cold water, or even hot water, does not make it safe with an open flame near by. Live steam forced through the vessel is the only way to cleanse it thoroughly and at the same time prevent an explosion.

It is necessary to clamp some metals together in order to keep them in close contact for a good soldering job around the edges.

In soldering leaky pots and pans, apply the solder on the inside. If the hole should be too large to fill with the solder, either plug it with a tiny wad of steel wool or apply a tin patch.

Do not use an acid flux when soldering tinware or radio wires; use a paste of resin. Always wash the article thoroughly after soldering with acid flux, using

warm water and soap suds. Resin flux work requires no washing.

When soldered joints, such as you might require for a radio antenna, are made outdoors it is advisable to paint the soldered parts, in order to check the crystallization of the solder. Use thick asphaltum paint for this purpose.

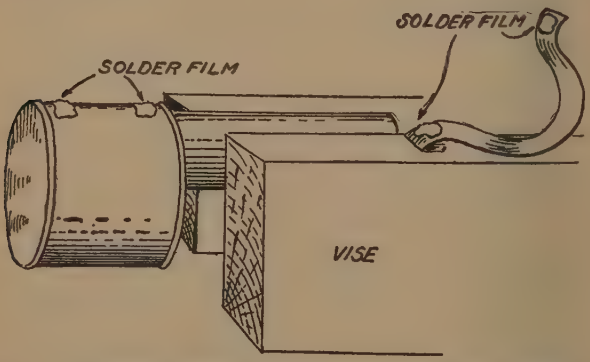


Fig. 112. Ready to Apply a Handle to Tin Cup from which it Has Become Separated.

To Make a Sweat Joint requires a little more skill than to do ordinary soldering. Such a joint is frequently necessary between two metals which do not project at the edges, affording little or no hold outside for the solder. After cleaning all parts, warm them a little and "tin" or cover the surface of each part by applying a very thin coating of solder. If the solder seems too thick, wipe most of it off with a rag while it is still in a molten condition.

Bring the two metals together in their relative positions, and clamp them firmly. Apply the soldering

copper or the flame of the blowtorch, and heat the metals until the solder is seen to be flowing at the edges. Let the parts cool naturally, whereupon the job will be done. This makes a very neat soldered joint. *Figs. 112* and *113* show how to repair the broken handle of a tin cup by this sweating method.

To Solder Graniteware or Enamelware, proceed in this manner: Clean all exposed metal, where the

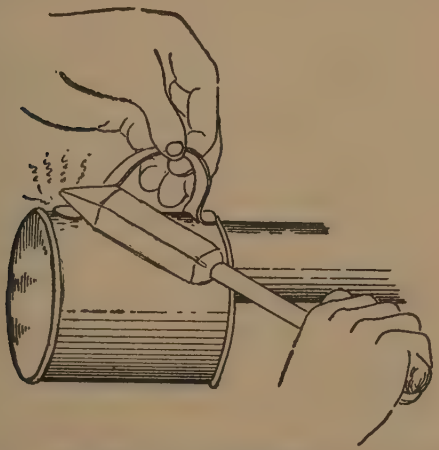


Fig. 113. Soldering the Handle Back on the Tin Cup.

enamel is broken off, by scraping with a knife or the end of a file, finishing with emery cloth until the metal is bright. Apply chloride of zinc soldering flux, and use ordinary fifty-fifty solder. Be sure all exposed parts of the metal are tinned to prevent rusting, else apply a couple of coats of hard enamel over the spot. Wash the dish with warm water and soap suds.

To Solder Cast Iron, grind the parts on an emery wheel, if possible, or file or chisel them until they are clean and bright, but not polished. Apply a flux of raw muriatic acid. After a few minutes of soaking, wash off the acid with water. Apply chloride of zinc solution to a small portion of the metal at a time. Rub in the solder, working very slowly, to make sure that the cast iron parts are heated up to the melting point of the solder.

Where the soldering copper is too small for the job, use a blowtorch. Fifty-fifty solder is the grade desired. It is a slow job to solder cast iron successfully, but not difficult if care and patience are exercised.

Aluminum Soldering can be done with a special solder. Procure a good brand of aluminum solder, which should have a piece of stearine or flux with it. Heat the soldering copper and file it free from all common solder. Do not attempt to tin the copper, as it should be used perfectly clean and bright.

If it is a hole in a dish which you wish to repair, clean the surrounding metal by scraping, and give it a final roughening by using coarse emery cloth or a file. When the soldering copper is very hot, but not quite red-hot, melt a little stearine around the hole, then melt off enough solder to do the required filling.

This solder will not flow like the ordinary kind; therefore, use care in placing it in just the right spot, and crowd it into the aperture as quickly as possible. The queer, putty-like solder will not make a permanent repair, as it will break out and come off entirely in a few months, but it will keep a valuable dish in service for some time.

XI

GLAZING REPAIRS

KEEPING up the glass fixtures about the home is not a difficult task at all; in fact, there are few girls or women who cannot themselves do a good job of window glazing, if they have some helpful suggestions. It is not economy, nor is it comfort, to let a broken window pane stand that way for weeks and weeks, perhaps with an old rag stuffed in it to keep out the cold winds, just because a professional glazier cannot be secured to make the repair. Cracked picture glass, too, is easily replaced, and there is no need to put a prized painting away in a closet or an attic just because a professional picture framer is not immediately accessible.

The Tools for Glazing are very simple and inexpensive. They are illustrated in *Fig. 114,* and consist of a glasscutter, a puttyknife, and a yardstick.

The Glasscutter will cost only 10 cents at a hardware store, and the puttyknife and the yardstick will cost no more.

A Home-made Puttyknife can even be made out of an old tableknife, by cutting off a portion of the blade, as illustrated, then grinding the end down a little thinner.

Glue a strip of felt or flannel to the under side of the yardstick. This will keep it from slipping on the glass while using the stick as a straight-edge.

Glazing Supplies which you will need, in addition to the tools, are illustrated in *Fig. 115*. These con-

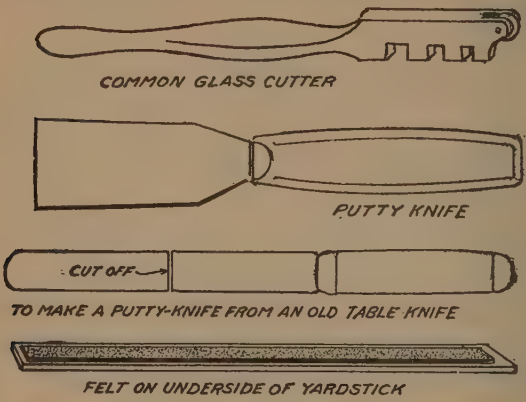


Fig. 114. Tools for Home Glazing.

sist of putty, glazier's points, and a small quantity of boiled linseed oil, all procurable at a hardware store.

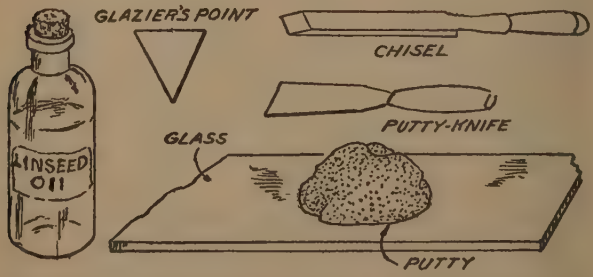


Fig. 115. Everything Ready for Glazing in a New Window Pane.

The oil is for softening up the putty when it gets too hard. The putty is mostly for keeping out the cold,

and the glazier's points are for locking the glass in the rabbet of the sash. The chisel shown in this illustration is an old wood-working tool, which can be more or less dull; it is used in removing hard putty from old window sash when new glass is to be put in.

Window Glass, such as is commonly found in the windows, doors, and picture frames of the home, is either of the thickness called "single strength" or the thickness termed "double strength." (See *Fig. 116.*) Single strength is cheaper to buy, and averages about

Fig. 116. Grades of Window Glass.

1/16 inch in thickness. It is used mostly in small panes, as wind pressure of a severe kind might break it if put in large spaces. Double strength glass averages about ⅛ inch in thickness; it is used in the larger windows.

Plate Glass is also sometimes used in homes, but mostly in fancy windows, French doors, and front doors. It is considerably thicker than common window glass, is of clearer quality, and costs more. Some of it is beveled, adding again to the expense. You cannot reduce the size of a section of plate glass that is beveled, and use it in a smaller frame, unless you are content to omit the bevel. Owing to its comparatively great thickness, plate glass is somewhat more difficult to cut than window glass.

Mirrorplate Glass varies considerably in thickness, running from about 1/16 inch to ¼ inch. Most

of it is plain, but some is beveled. When a glass is cracked, it is a good plan to cut it down for a smaller frame, getting a new glass for the original frame. Owing to the mercury coating on the back, this glass is a little more difficult to cut than common window glass.

Stained Glass is sometimes used in doors, windows, and lamps. It is rather expensive, and comes in comparatively small sizes. This is quite difficult to cut, owing to its irregular surface, and should be ordered cut to the size desired.

The Place to Get Glass is at a special glass supply house; but if there is none in your town or city, go to the largest hardware store. If the dealer does not have just what you need, he will get it for you or advise you where you can secure it.

To Carry a Large Sheet of Glass Safely, as in returning to your home with it from the store, be very careful to hold it in a perpendicular position, between the arm and the side of the body, and have the handling edges covered with heavy paper so that there will be no danger of getting cut. Never lift a large sheet of thin glass in a horizontal manner, as the excessive unsupported middle weight will cause the sheet to shatter. Always handle it edgewise.

When a Crack Appears in the Window or Door Glass, the crack may be so close that a new glass will not be immediately needed; that is, the outside elements of the weather may not be able to penetrate the crack appreciably and you can take your time about making a repair. Some fine cracks of this kind, if not joined by others, will stand for months and even years

without other damage to the building than that of appearance.

But, as a rule, a cracked glass makes a weaker glass, and if you do not care to replace it at once, and the crack is quite long, it will be better to reinforce the break rather than to let it go in its original state of rupture.

To Reinforce a Crack in a Glass Window or Glass Door without removing the frame, drill a hole for a small stovebolt about midway of the crack, where it springs apart the easiest. Use kerosene to lubricate the drill point, and have an assistant hold a block on the other side of the glass, to give it stiffness while you drill. Glue some felt on one side of two 1-inch metal washers, and snugly clamp these to the glass with the bolt, one washer on each side of the break.

To Make an Emergency Repair of a Window Glass or Door Glass with a Hole in It—for instance, such as might be done to keep out bad weather until a new glass can be secured—there is little you can do except to stuff some soft material, such as a cloth, into the opening. However, if the hole is very small—say about the size of a marble—it is possible to make quite a permanent repair by the clamp method described in the preceding paragraph, using large discs, preferably made from thin wood, instead of metal washers.

Cutting Glass is done with the type of simple glasscutter shown in *Fig. 117*. It consists of an iron frame, one end of which acts as a handle or support for the hand and fingers, the other end having a pivoted cutting disc. When the disc gets dull the

entire instrument should be discarded. A disc, however, will last a long time.

One edge of the glasscutter frame has several different-sized notches. These are to accommodate the different standard thicknesses of glass, and are used as a sort of plier for breaking off sections of glass which are too small to press off with the fingers. Of course an incised line must first be run before the glass will break evenly with the aid of the notches. This type of glasscutter works best on straight work, but it will also cut curves, although this is much more difficult.

It goes without saying that all grease and dirt should be removed from the glass before cutting. In addition, see that the glass rests on a flat, level surface, such as a table top, or the sheet will be broken at the very start because of the pressure upon the cutter. If no level surface can be found, select the best surface you can and lay upon it several thicknesses of newspapers or cloth, to take up the deficiencies.

The first thing to be done when preparing to cut a section of glass from a larger sheet is to select one good edge and one good end that are at right-angles with one another. If no such outlines exist, you must produce them by making one or more cuts, removing the uneven parts. Measure off, on two edges and one end, the size of the section of glass you wish to cut out. Mark these points with a grease crayon, a piece of sharpened soap, or by using the glasscutter. (See *B, Fig. 117.*)

At *A* is shown the method of holding the glasscutter. The cut is made with a firm pressure, as the side of the cutter frame runs along the straight-edge. As a

rule, most beginners can cut better by pulling the tool toward them than by pushing it away from them, but expert glaziers are adepts at either method.

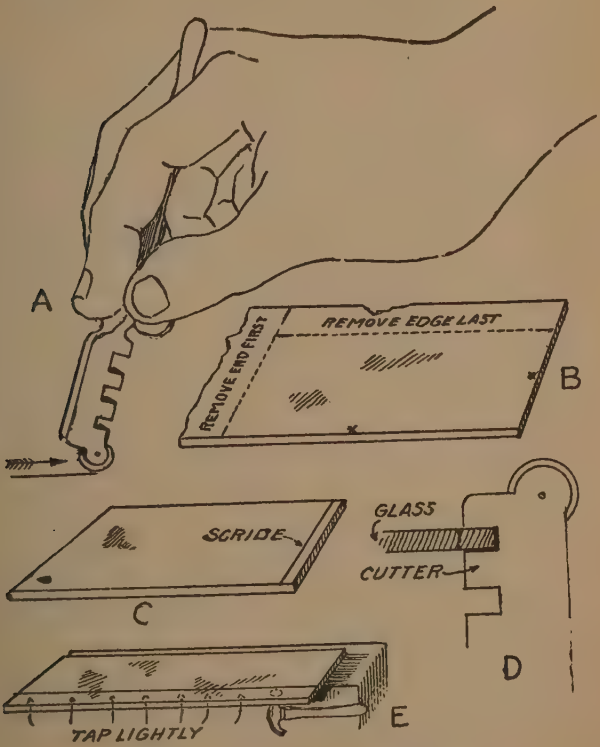


Fig. 117. To Cut Glass Successfully.

Try to avoid going over a spot twice. Such a practice usually dulls the cutter upon the tiny particles of glass freed at the first passage. It is far better to

press heavily enough at the outstart, and maintain such a pressure throughout the course of the cut. If you handle the glasscutter in the right way, and it is sharp, you will have no trouble in scribing a clean, deep, white line through the surface of the glass at the first effort. (See *C*.) You can then easily break off the surplus glass with your fingers, or by tapping under it, as at *E*. As stated before, if the border is narrow, use the notches or breaker teeth in the glasscutter for nipping it off, as at *D*.

To Set a Pane of Glass, it is generally most convenient to remove the sash from the window frame. This can be accomplished in the manner described in Chapter VII. The fact of the matter is, it is quite necessary to remove the sash if the window to be repaired happens to belong to the up-stairs portion of the house. If, however, it should be down-stairs, it is possible to do the work while standing upon a step-ladder or some similar elevation.

Use an old chisel or a puttyknife to remove the old putty. Lacking either of these tools, try a butcher-knife. Be careful not to chip away any of the wood.

When the old glass is out and the rabbet in which it lay has been made clean, insert the new pane of glass. If it sticks anywhere, either cut off some glass or remove some wood. The glass should have a little play, to allow expansion in warm weather, also to give the sash a chance to swell normally in damp weather without crowding it and causing a consequent breakage.

Fasten the glass in the sash with glazier's points. Drive these in with the side of your chisel, as shown

in *Fig. 118*. A half-dozen points, well spaced, are sufficient for one side of a good-sized window. Try the glass, by pressing with your fingers, to make sure it does not rattle; if loose, remove the poorly set points and replace them in closer contact with the pane.

Place your putty on a sheet of broken glass or a plate. (See *Fig. 115*.) If it is too stiff to spread well

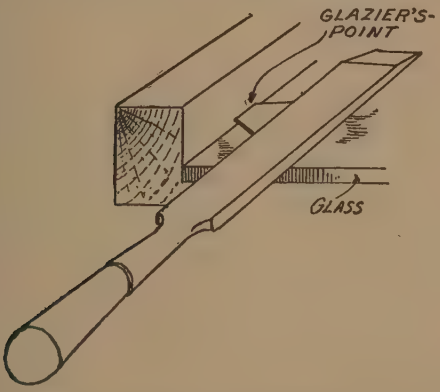


Fig. 118. How to Apply Glazier's Points.

under the puttyknife, break it up and pour on a little linseed oil. Crush the mass together with the knife, kneading it until it is of proper consistency—about like butter.

Take up a small quantity of the putty and roll it out into a pencil-like roll, as at *A, Fig. 119*, using the palms of the hands in this process. Lay the roll of putty along the rabbet and spread it out evenly with the puttyknife. (See *B*.) Add more putty if necessary to bring the filling up to the top of the rabbet and out to its lower edge, as seen through the glass.

Proceed with other rolls of putty, carefully smoothing them down into a good bevel, until the entire glass has been nicely puttied in.

Wipe off the glass and sash with a cloth. Allow the putty to stand until it is thoroughly hard, then give it a protective coating of the color of paint desired.

To Reglaze a Picture Frame, remove the paper backing and use a chisel or puttyknife to pry up the

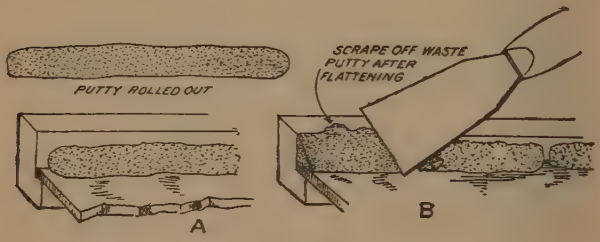


Fig. 119. Laying the Putty.

molding. Carefully remove the nails from this, straightening out any which may be bent, so that you can use them again in the same holes. Take out the cardboard cover.

Lift out the old glass, substituting the new; but first make sure that the side which will be turned toward the back is absolutely clean, for it cannot be cleaned after the molding is put back. Put in the cardboard cover.

Now carefully refit the molding strips as they were before. When you replace the nails, force them in their old holes. If it is necessary to put them in new places, be very careful that they do not go through and

strike the glass, as in the left-hand picture in *Fig. 120*, for this will crack the glass nine times out of ten.

Glue on new backing paper, to keep out the dust, and the job is finished and your picture is ready to rehang.

To Reglaze a Mirror, proceed in the same manner as with a picture frame. If the old glass is only

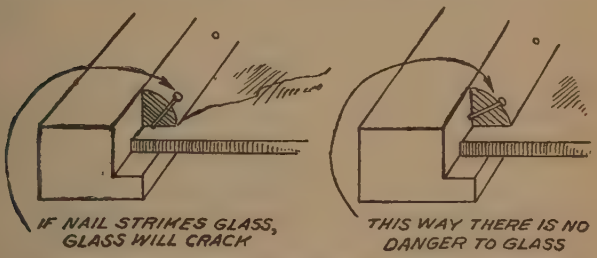


Fig. 120. Incorrect and Correct Way of Applying Molding.

tarnished or scratched on the mercury side, and without cracks, you can save the price of a new glass by getting a mirror manufacturer to resilver it for you.

To Reglaze an Automobile Windshield, first get the new windshield from the dealer or manufacturer, as such glass is made to order. With screwdriver remove the metal or wooden molding retaining the old windshield, displace the rubber or felt compression strips, and take out the glass.

Set in the new glass, placing the compression strips where they go, replace the molding and tighten all screws very securely.

To Reglaze an Automobile Headlight, remove the retaining ring or band by compressing it, take out the old glass, then substitute the new, which is generally

of special glass and which must therefore be secured from the local agent or manufacturer of the automobile.

To Reglaze a Bicycle Lamp, proceed in the same manner as with an automobile headlight.

To Cut Out Small Glass Discs, the ordinary glasscutter is at a decided disadvantage. But the job can be done, surprising as it may seem, by using a pair of household scissors of medium size. First mark out

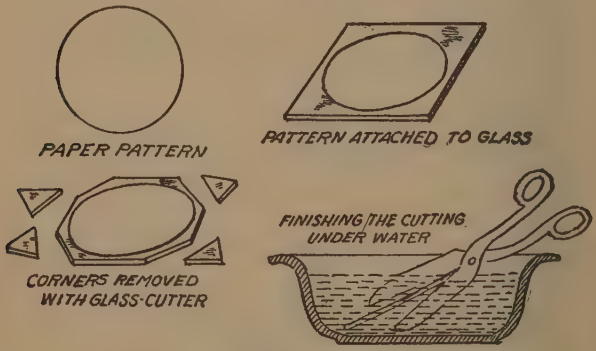


Fig. 121. Cutting Out a Glass Disc.

the circle with a grease crayon, or a sharpened piece of soap, or paste on a paper pattern. With the glasscutter, cut out a square of glass whose edges will pass close to the circular outline.

In one hand hold the piece of glass, submerged in a pail partly filled with water. With the other hand, manipulate the scissors upon the glass, cutting away the border as you would paper or cloth, except that the work will proceed better if all cutting be done well back in the throat of the scissors. (See *Fig. 121.*)

Of course this operation dulls the scissors somewhat, but this is no great handicap to any householder who has a grinding wheel, for he can soon resharpen them, as described in Chapter II.

To Drill Glass (*Fig. 122*) is sometimes desirable, and the task is not nearly so difficult as it might seem.

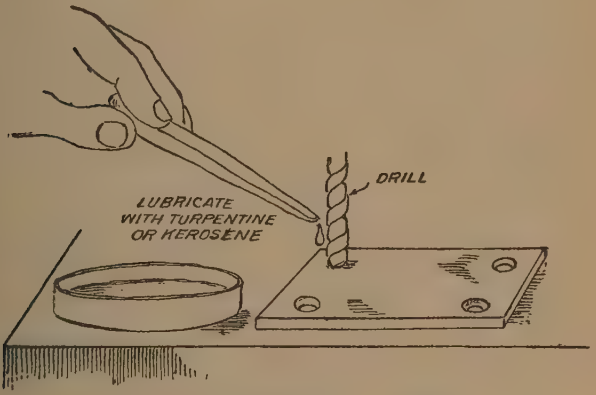


Fig. 122. Drilling Holes in Glass.

Place the glass upon a firm, level foundation, and use a common twist drill in a brace or hand-drill. Lubricate the drill point with kerosene or turpentine as you revolve the drill. This will produce a clean-cut hole in any kind of glass, of any thickness.

XII

STAINING AND FILLING

As long as interior woodwork and furniture are made from wood, just so long will there be frequent occasions when the enterprising home-owner will want to do some staining, and perhaps a little filling, in his laudable effort to keep up the place or to improve it.

Stains are a colored, transparent coating, put on

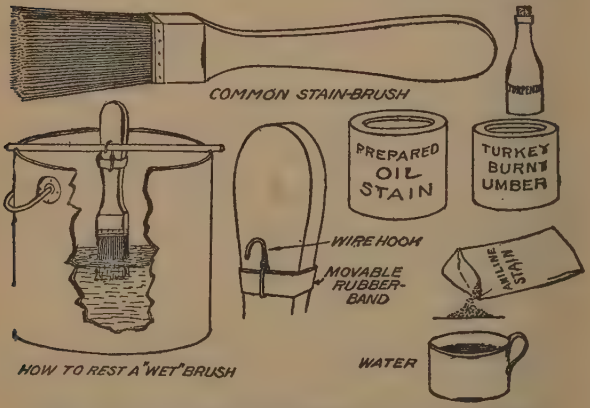


Fig. 123. The Tools and Supplies Used in Staining.

wood for the purpose of beautifying it. They do not protect it from the elements, as do paints and enamels, shellacs and varnishes, but merely serve the duty of giving the natural wood a different color.

A staining outfit is shown in *Fig. 123*.

The kinds of stains in popular use are *water stains, oil stains,* and *spirit stains.*

Water Stains stand supreme. They come in powdered form, are inexpensive, dissolve readily in water, brush on easily, and are the best stains for bringing out the full beauty of the grain in almost all woods. They cannot, of course, be made to "take" over oil stains, over shellac, over wax, or over varnish. If a refinishing job arises where such finishes have been used, in order to apply water stain you will have to remove every bit of oil or gum coating.

As a rule, therefore, water stain makes a poor medium for recoloring spots where oil stain and the gum coatings have been used. But if the former stain were a water stain, it is the best stain you can apply. As a test, put a few drops of water on the spot to be retouched; if the water is absorbed, it shows a water stain will be likewise absorbed; if the drops do not disappear in a few minutes, the conclusion is that some other type of stain must be used, unless you remove all the old finish, as stated previously.

Water stains are procurable in 4-ounce and pound lots from local paint stores or from mail-order houses in the larger cities. The stains come in the following popular mixtures:

Red mahogany, brown mahogany, Sheraton brown mahogany, Adam brown mahogany, Toona mahogany, Colonial mahogany, American walnut, antique walnut, Italian walnut, baronial oak, Jacobean oak, golden oak, weathered oak, Mission oak, fumed oak, gray maple, and Early English.

Oil Stains are commercially used only on cheaper goods, such as must be sold at a very low price. These stains can be purchased ready-mixed, or you can mix

them yourself by buying the oil-ground color, then adding turpentine to the pigment.

The tendency of oil stains is to cloud the grain of the wood. On plain woods, such as white pine or basswood, they appear very well, but the beautifully figured hard woods look better to be given a water stain coating.

Spirit Stains are used mostly in repair work—in touching up damaged spots. For this purpose they are ideal. As they set fast, you must wield the brush with more speed than with water or oil stains, in order to prevent visible laps and other deficiencies due to brush work.

Such stains come in powdered form, in most of the colors common to water and oil stains. To mix them, use alcohol. As with all other kinds of stains, the more fluid used, the lighter will be the color that you will obtain.

Brushes for Staining do not need to be of the finest quality; in fact, as a rule, one costing 25 cents is plenty good enough. There should be two about the household, one ½-inch round brush and one 1½-inch flat brush.

Unless a brush is used every day, it should be thoroughly cleaned immediately after every using and laid away in a clean place. To clean it, use the fluid with which your stain is mixed—water for water stains, turpentine for oil stains, and alcohol for spirit stains.

A Handy Brush Support is shown in *Fig. 123*. It is a hook, made of wire, which can be fastened to the handle of the stain brush with a rubber band, and

which will suspend the brush in the stain pail in the best position to prevent damage to it.

The Preparation of Wood for Staining involves a good cleaning and smoothing with sandpaper. When you are through with this operation, there should be no scratches or other marks upon the surface.

If possible to avoid it, never sand across the grain; rub the paper in the direction of the grain. If the woodwork is too rough to respond to the use of fine sandpaper, try a coarser grade until the prominent defects are eradicated, then use a fine quality of paper for finishing.

Do not sandpaper flat surfaces with the paper held in the hand; use a softwood block and wrap the paper around it. For concavities, whittle out a convex-shaped stick or block that will fit, and put the sandpaper around this. Remember that the harder you press the quicker the defects will vanish.

If you are treating hardwood, scraping will remove deep defects faster than sanding. Scrapers will not work well, however, on softwood, which must be sanded throughout.

If you use a water stain on new work take a damp cloth and wet down all surfaces. This will raise the grain. When dry, give the work another thorough sanding, to reduce the grain. Follow with a second dampening, and give a second cleaning up with the paper. This wetting down and resmoothing pre-swells the grain so that when the water stain is applied the grain will not materially rise again.

All holes and other blemishes in the wood which cannot be removed by sanding, should be filled. Putty

is the carpenter's friend in this operation, but the cabinet-maker, who is a finer workman, prefers to use stick shellac. This is burned into the crevices by touching a hot iron (an old file will do) to it. Select a stick of the color your wood is to be stained. Such sticks can be purchased of wood-finishing supply houses for 15 cents each.

The stick shellac filling gets hard in a few moments. The surplus shellac on the wood should then be sanded down so that none appears on the surface, leaving it in the hole only.

Another substance used for filling cracks and holes in cabinetwork is called "cabinet-makers' cement." This is a prepared mixture, in a sealed can, which can be applied cold a good deal like putty, but which sets sooner and forms a tougher body.

Other hints on sandpapering and cleaning up woodwork will be found in Chapter V.

To Remove Old Stain, such as is required when you wish to completely refinish a piece of woodwork, the best way is either to plane it off or scrape it off, giving the surface a final smoothing down with fine sandpaper.

Staining requires a reasonable amount of care on your part, even if it does not demand much skill. Mix your stain in as low a vessel as possible, so that it will not upset easily. In withdrawing the brush, to apply stain, squeeze the brush against the inside of the vessel's neck; this discharges the surplus stain back in the dish and prevents the stain dripping from the brush as you transport it to the work.

Wear an apron, or other covering, to protect your

clothes. If, by some mischance, you do spill stain upon your good clothes, remove the spot by using the fluid with which the particular stain is dissolved—and do not wait to do it, either!

When applying stain to a flat surface, hold the brush in the manner shown in *Fig. 124*. You will get in

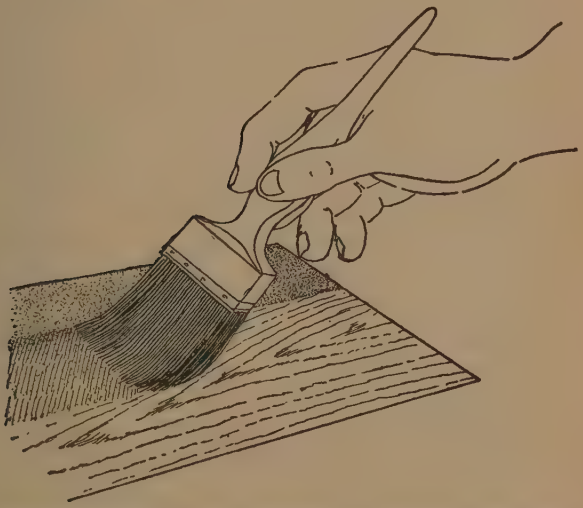


Fig. 124. How to Hold the Brush in Smoothing Out Stain, Paint or Varnish.

some close corners where you may have to alter the position of holding, but the method illustrated should always be adopted if possible. This position tends to force the brush smoothly over the surface, without damage to the hairs, and is the most untiring one that can be adopted.

Do not start in the middle of a large surface. In-

stead, begin at the edge or end, then make straight paths, one after another, down the work, allowing a very slight lap and working as fast as you can. (See *Fig. 124* again.)

If the object you are to stain is a cabinet or anything else having inside parts, always do the interior first, then the top portions, then the bottom ones.

Never begin to stain a piece of work, however, until you are sure you have mixed up enough stain to do the entire job. Nor should you partly do a certain piece of wood composing your structure, and then leave that part to do some other part. By the time you come around again to that unfinished portion, the narrow streak of stain will have set, and your lap in making the remainder of the same color will be sure to show, for on the lap you will have applied two coats instead of one, as elsewhere. Completely finish, therefore, one portion of the object before proceeding to the adjoining portion.

Leave no surplus stain on any surface. Before quitting a part, see that you have carefully stroked out all little puddles and given a uniform color to the entire surface.

On account of its outcropping pores, end wood will absorb a great deal more stain than the other surfaces of a board; hence, after staining, such ends will appear considerably darker than the edges and sides. To overcome this inequality of color, the best finishers pour a little of their stain in another vessel and add sufficient water to it to produce the desired lighter tone. Of course this diluted color is applied only to end wood.

If there are light colored patches on your job when you are through—patches which seem to resist absorbing the stain—the chances are there is glue or grease covering those spots. Your remedy is to scrape off the troublesome coating and apply stain again.

Drying the Stain Coat is best done in a room of moderate temperature. If an oil stain has been used, it is not safe to apply coatings of varnish over the stain before the following day. If spirit stain has been used, it will be dry in 30 minutes. If a water stain has been applied, the drying may take an hour.

Setting the Stain Coat is done by applying a very thin coat of shellac. This coat should be prepared by taking one part of orange shellac and reducing it with seven parts of alcohol. It will stiffen the fuzz raised by the stain and be a great aid to the sandpaper in cutting off these little fibres.

When this coat is dry, which ought to be in 30 minutes or less, it should be lightly sanded down with No. 2-0 paper, until all roughness has disappeared and the polish has been noticeably dulled. The piece of work is then ready to be filled.

Wood Fillers are a composition designed to fill up the large pores of wood so as to afford a smooth surface for laying on the final gum coatings, such as wax, shellac, or varnish. Repeated coats of shellac and varnish will in themselves fill up all ordinary fibre crevices, but the filler will do it quicker and at less expense. The best wood fillers are composed of hard silica, linseed oil, and dryer. To these basic ingredients is added the proper coloring matter to produce the shades desired.

Commercial wood fillers, however, do not come ready to use. They are in paste form, in cans of varying size, and when you want to use a little filler it is your job to reduce the paste by thinning with naphtha. A ratio of about ten pounds of filler to one gallon of naphtha will suit the average wood. Very porous woods require a heavier mixture.

Applying the Filler with a brush gives the best results. Work the brush across the grains, then with the grains, forcing in the filler. In a few minutes the surplus filler will begin to look flat and dull, whereupon it should be cleaned off the surface with a clean pad of coarse cloth or burlap. If any spots of filler are left, a cloudy effect will appear when shellacked.

The more time filler is allowed to dry in the pores the better. Let it stand not less than 24 hours. Forty-eight hours will give best results.

While in use all fillers should be kept thoroughly stirred with a small paddle. This prevents the heavy silica from precipitating to the bottom.

As soon as the filler is dry, the woodwork is ready to receive its gum coating. The application of this will be treated in the next chapter.

XIII

WAXING—SHELLACKING—VARNISHING

The three subjects named at the head of this chapter constitute all of the methods used in giving household interior trim and furniture a lustrous, transparent, protective coating which does not conceal the grain or pattern beneath. Enamels and paints, protective agents of another order, are absolutely opaque and, therefore, completely conceal all characteristics of the material upon which they are laid.

Wax, as it is sold for household finishing work, is principally a combination of bee's wax and turpentine, in varying degrees of solution, to fit it for various kinds of surfaces. It is not a very expensive type of coating, and is, perhaps, the easiest of all polishes for the inexperienced to apply.

Wax is not only a polish but a wonderful preservative; it forms a thin, protecting film over the under finish, similar to the service rendered by a piece of plate glass over the top of a desk, table, or dresser. It is impervious to water or dust, and it will resist all forms of scratches and abrasions more than any other finish that can be applied to woodwork. Should a mar appear, all you have to do to restore the surface is to apply a little more wax on the spot, then polish it by rubbing briskly.

There are three common forms of wax—paste wax, liquid wax, and powdered wax. The paste wax is used for polishing floors of all kinds, whether covered

with wood, linoleum, tile, or marble. The liquid wax is used for polishing furniture, interior trim, and automobiles. The powdered wax is used for imparting to any wooden floor a first-class surface for dancing.

A waxing outfit is shown in *Fig. 125*.

Applying Wax, as stated before, is not at all a difficult task. It can be put on brand new woodwork, by using repeated coats, with very satisfactory results,

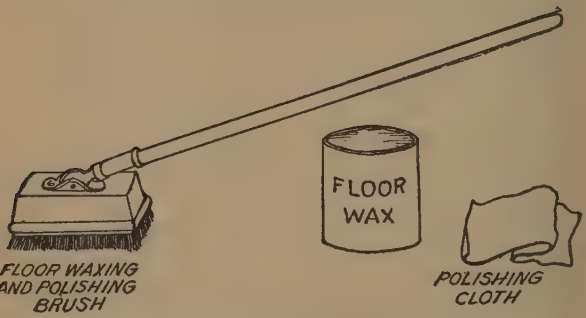


Fig. 125. Tools, etc., for Waxing. The Brush Is Not an Essential.

although a more permanent and lustrous finish will result if the material to be waxed has first been shellacked or varnished. The shellac and varnish give the essential body, prevent the wood from absorbing the wax, and the latter lays upon the surface, imparting to it a good wearing film of velvet-like softness.

To use prepared wax all you need is the wax itself, procurable at any paint or hardware store, and two cloths. Some people may tell you that you will require a special mop or floor brush (like that in *Fig. 125*), but you do not; such things may be conveniences,

though they are not necessities. Simply apply the wax with a damp cloth and then polish, ten minutes later, with a dry cloth. Very little rubbing is required to produce an exquisite polish of great beauty and durability.

The liquid wax is best applied with a soft-haired brush.

To Thin Thick Wax, pour a little turpentine upon it and stir the turpentine through the body of the wax by using a puttyknife or a paddle whittled out of wood.

Shellac, in its crude state, is a resinous incrustation formed on the bark, twigs, and branches of various small trees in India and Siam by an insect known as the *coccus lacca.* This tiny creature sucks out the sap, ejects it as a sort of protective cocoon about its body, dies within the incrustation, and the gummed twigs are broken off and carried away to the refining mills by the native lac gatherers.

Shellac finally reaches you in four forms—in thin, orange-colored chips known as orange shellac, ready for you to prepare by dissolving the chips in alcohol; in prepared orange shellac form; in white, bleached lumps, known as white shellac, ready for you to prepare by dissolving the lumps in alcohol; and in prepared white shellac form.

If you use but little shellac, it is best to buy it prepared.

Orange Shellac is the general-purpose shellac, and the cheaper of the two. It is largely used as an undercoat for fine varnished woodwork or for waxed work. It is also of great value as a first coater on all

pitchy woods, such as southern pine and cypress. The shellac coat hermetically seals up the pores of the wood and keeps the pitch from oozing out. It is especially essential to use in coating knots in new lumber when painting houses.

White Shellac is made by bleaching the orange shellac gum until it is deprived of its coloring matter and has become a milky white. This comparatively expensive shellac should never be used on dark-colored or medium-colored groundwork, its only legitimate office being that of a coating agent for light colored surfaces or those which are not to be stained at all.

Substitute Shellacs, since the war, have been placed on the market in great profusion, to fill the demand for a gum coating which would be lower in price than shellac itself. Most of the substitutes are built principally upon a foundation of common resin, a very brittle gum, and while they are good enough for cheap work, such as coating knots and pitch pockets in new lumber, they should never be used as an undercoat for high-grade furniture.

Applying Shellac calls for care and neatness. The shellac itself should be kept clean; should be protected from dust as well as from evaporation by placing it in an air-tight, covered vessel of some sort. Do not allow the shellac, when withdrawing the brush, to drizzle over the edge of the vessel and down its sides; instead, squeeze out the brush against the inside of the container until it carries a light enough charge to prevent drippings.

On broad surfaces use a broad brush; on narrow surfaces, a correspondingly smaller brush. When you

buy a brush, also just before you use it, pull gently at the hairs to see if any of them are loose. Refuse to buy a tool with loose hairs, and do not use such a one, for the hairs are sure to come out in brushing on the shellac and will stick to the surface, making an ill-looking finish when dried.

If you have to use quite a wide brush on edges, handle it in such a way that the hairs will not straddle the edge; pull the brush along on its side.

As in staining, varnishing, or painting, do interiors first when you shellac, then edges, and finally the large exposed surfaces.

Do not leave one surface to go to another without first carefully inspecting the last surface to see that there are no bubbles or runs upon it. If you find any such, brush them out immediately.

Work fast. Remember that shellac dries fast; that you cannot spend much time upon any one surface without damage to it. The quicker you can thoroughly cover a surface the better job you will have.

Never go back and recoat a surface; that prevents the under coat from drying as it should. Just give the entire article a single, thin, uniform coat.

In doing broad surfaces you can expedite the work if you will first coat across grain rather liberally, leaving small spaces of wood between; then neatly brush out this oversupply of shellac by going with the grain, until you have fully and uniformly coated the entire surface.

If the coat should look curdled or milky anywhere, it is evidence of "bloom," which is a condition arising from the fact that you have either applied shellac that

was too thick as a mixture, or that you have put on too much. In such a case, the only recourse is to remove all the shellac on that surface as soon as possible.

To do this, pour on the surface a little alcohol, then rub briskly with an old cloth until you have removed the coat, whereupon a new one can be applied.

Apply your coats in a room as free from dust as possible, and in a temperature of about 70 degrees. Windows should be closed if winds are blowing or a strong draft exists.

Should dirt accidentally get into your coat, do not try to save it by picking out the particles; you will only make matters worse. Clean off the entire surface, shellac and all, with alcohol, and do the job over.

Drying Shellac takes but a comparatively short time, if the conditions are right. Ordinarily a coat should become hard in 30 minutes. To test, find a spot where the coat looks thickest and press your thumb firmly upon it, holding the thumb in contact for several seconds. If, upon lifting your thumb, no print is manifest, the coat may be considered to be fully dry.

To Apply a Second Shellac Coat, as is sometimes required in order to build up a good body, first lightly smooth off the roughness of the first coat by using No. 2-0 sandpaper. Then dust the surface, and apply the second coat. This should also be smoothed off before wax or varnish is applied.

To Clean the Shellac Brush (which should never stand any length of time out of the fluid), place the brush on an old newspaper and pour a little alcohol over the hairs. Holding the handle up in one hand, gently prod the hairs with a blunt stick, adding more

alcohol from time to time and wiping off the hairs with a cloth or some cotton waste. Another way is to pour a little alcohol in a shallow dish and chuck the brush gently up and down in this, wiping it occasionally and changing the discolored fluid for fresh until the brush is free of the shellac.

Varnish is a transparent liquid made from various vegetable gums, linseed oil, turpentine, and

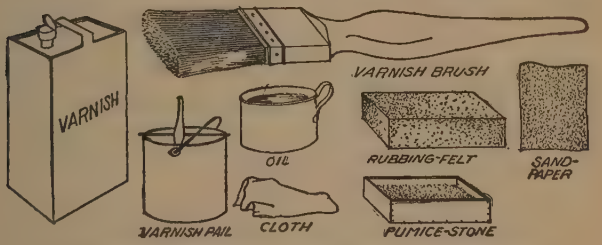


Fig. 126. Tools and Supplies Used in Varnishing.

naphtha. Some of the gums used are obtained in foreign countries at great expense; therefore the particular varnishes containing these gums bring comparatively high prices, but are usually well worth all that is paid for them.

Varnishes are made with great care and exactness in quite a number of grades, each grade adapted to some certain use, and you should always make it a point to secure the kind of varnish best adapted to the job you have in hand.

The spar types of varnish contain a large amount of oil, because they are intended to be outside varnishes, exposed to the weather. They are very tough, elastic, and fairly hard. Water does not hurt them, and they

will stand a surprising amount of extremes in temperature without injury. They dry very slowly, and will not rub up to a very high polish, as will harder varnishes, but for general use, inside the house as well as outside, there is no class of varnish that will render as good service. They are excellent for porches, outside doors, automobiles, boys' carts, boats, flagpoles, fishing-rods, and almost any other article exposed to the elements. In the house, they are unsurpassed for recoating tables, especially table tops which may be subjected to accidental spillings of hot or cold liquids, and they are also very fine varnishes to use in refinishing any kind of old furniture, or finishing new pieces, providing you do not care for a high-gloss rubbed surface.

Strictly interior varnishes should never be used on outside work. They are limited in oil content, and marked variations of temperature, or the contact of water, will check, crack, and whiten them. Such varnishes are intended solely for the inside woodwork of the home, such as the insides of outside doors, all inner doors, door casings, inside window trim, baseboards, and the like. Buy a good grade, not the cheapest, and adhere strictly to the directions accompanying it.

Floors require a very hard, tough, and pliable varnish, hence a special floor varnish should always be used if you plan on coating your floors. Do not use regular interior varnish for this purpose. This floor varnish will, however, prove of considerable worth as an all-around coater, for it can be applied to refinishing jobs on furniture with very satisfactory results.

However, a special furniture rubbing varnish is best if you want to apply varnish to new or old furniture so that you can rub the coats put on until they have a smooth, velvety sheen.

The best furniture of our day is all hand-rubbed after drying; only the cheaper grades are sold as they dry—in the shining, glary gloss.

A good quality of varnish will cost in the neighborhood of $4.50 per gallon.

Colored Varnishes—that is, varnishes which contain coloring matter so as to permit their use without a prestaining of the woodwork—should be avoided, except for touching up light spots on old furniture. On new work, or old work which has had the original stain removed, it is always better to put on the stain separately rather than in the varnish, for varnishes containing stain are always more or less cloudy and produce a foggy-looking job. Therefore, avoid buying such things as "mahogany varnish," "walnut varnish," etc.

All varnishes should be kept in a moderately warm place, well sealed against the air, and every effort should be made to see that no dirt or dust gets into the container. If the varnish gets chilled it will not flow freely enough to do a good job; in such a case it should be placed in hot water until the heat has restored it to prime condition. If it is slow to respond to heat alone, add sufficient turpentine, stirring as you pour it in, to thin it to the proper consistency.

Brushes for Varnishing should be of first-class quality, with the hairs long and pliable and set in some tough composition so they will not pull out. A good

brush costs from 50 cents to $1.00, depending upon size. You will probably need a 2½-inch flat brush, also a 1½-inch brush, both of the varnish type.

Cleaning Brushes, as soon as used, is the only way to keep them in good condition. Turpentine is the best solvent to use. Pour a little in a shallow dish, let your brush soak in it for five or ten minutes, then, with a blunt stick, work out all the remaining varnish, drying the brush on cotton waste or an old cloth. Another good way to clean a brush, and one that will keep the hands equally as clean, is to lay the brush on an old newspaper, pour a little turpentine on the brush, prod it with a blunt stick until the fluid is much discolored, then put the brush in a new spot and repeat the performance, finally wiping out the brush on a dry cloth.

Applying Varnish requires more care and taste than skill. It is easy enough to master the proper brush stroke with a little practice, but it takes an inborn sense of neatness and system, also constant vigilance, to apply the varnish coats in the proper way and to protect them from dust.

Dust is really one of the biggest enemies varnish has. Extreme care must be taken not only to keep it out of the varnish container, but also out of the brush, off the wood before varnishing, and off the varnish coat while it is in process of drying. Moreover, the room itself in which the varnishing is done, must be as free from dust as possible to make it. It is well to sweep the apartment prior to coating, then sprinkle the floor with water. Nor should you move around in the place very much while the varnish is drying; especially, avoid

engaging in wood-working, as this is sure to create a flow of dust.

Do not apply varnish with windows and doors open; such openings create drafts and drafts stir up dust.

Most amateur varnishers dip the brush too deeply in the container, also apply the varnish too thickly. The best way is to pour into a cup or pail enough to do the job in hand, and take out sparingly and apply sparingly, brushing the surface thoroughly so that every particle of it will receive a uniform film without getting so much that the varnish body will soon begin to sag, gather into thick rolls, and then spread out into tiny runs. Such runs are very slow to dry, and when dry, are almost impossible to rub out and not leave a scar. For this reason, stand back, as soon as you have gone over a surface, and regard it critically from different angles. This precaution will show you, by reflected light, whether or not you have missed any portions or have put on the varnish too thickly in some places.

Do not varnish by night if you can help it. Artificial light is deceptive in its reflective properties. If you must use lamps, extra effort must be made to cover the surfaces thoroughly.

A temperature of about 70 degrees is best for varnishing. Varnish should never be applied when it is cold, as stated previously, nor should the wood or the room be cold. A warm, uniform temperature during the drying process is likewise desirable.

To work properly, the varnish should run freely from a stick when the stick has been dipped in the vessel and held up to test. A first coat can be applied

thinner than subsequent coats. It should not, however, be too thin, but of a fair syrupy consistency. If the varnish is too thick at any time, the addition of a small amount of turpentine will reduce it with a good stirring. In fact, varnish should always be stirred before using, if it has been standing more than a few hours.

Drying may require only 10 or 12 hours, although it may stretch into as much as 48 hours, all depending upon the warmth and air circulation in the room, and upon the particular composition of the varnish you have used.

To test for hardness, find the thickest portion of varnish you can. This will generally be along an edge. Press your thumb down very hard and hold it there a few moments. If, upon lifting the thumb, an imprint is left in the varnish, the coat is not sufficiently dry for continued operations. It must stand until absolutely rock hard.

When this condition becomes apparent by further test, another coat may be laid over the first one, if more than one coat is desired, which is usually the case where a good body is wanted. First, however, in order to secure as smooth a finish as possible, it will be advisable to lightly sand down the rough places on the first coat before applying the second. This is done with very fine sandpaper—about No. 4-0. Moisten the back of the paper slightly and hold it across the ball of the hand, rubbing the varnish lightly until its lustre has been removed and all dust particles and other upthrusts have been leveled.

Then dust off the woodwork very thoroughly, not

neglecting the corners, and apply the second coat of varnish.

If this is the last coat you wish to put on, it may be either left in a bright gloss, just as it dries, or brought to a velvety finish by rubbing down with pumicestone and oil, the former method being usually adopted for interior wood trim of homes and the latter method applied mostly to furniture. Use No. FF pumicestone and a little rubbing oil, both of which are available at a painter's supply shop. A block of rubbing felt, about 2 by 3 inches, will also be required. Put a few drops of the oil here and there on the woodwork, and sprinkle in a little pumice powder. Then rub with the felt block until the surface seems smooth. Wipe off the oily pumice. If the finish is smooth and velvety, it is done; if it is still somewhat rough, continue to rub until the proper result has been attained. Be careful to keep on plenty of oil and enough pumice to work freely and efficiently. Also guard against rubbing too long in any one spot, as this will wear the varnish completely through and show afterward, unless you touch up the spot by adding a little coloring matter to some shellac.

A final note of warning: Do not use substitute turpentine in thinning your varnish. Such a mixture is very likely to precipitate the gums in the varnish and ruin it. For cleaning brushes, the substitute fluid will do, but not as an ingredient of the varnish itself. There you should always use genuine turpentine.

To Remove Old Varnish, as in refinishing woodwork of any kind whose varnish has become checked, scaled off, or rough, the best way is to form a strong

solution of washing-powder and water in a basin and sponge the surface with this. Allow the suds to stand five or ten minutes, then apply more, until the varnish becomes softened enough to scrape off with a scraper

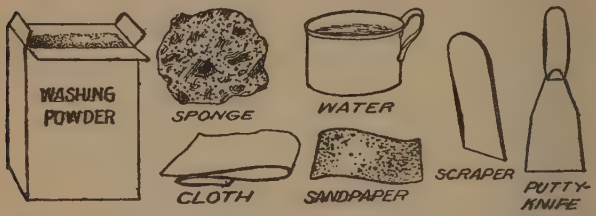


Fig. 127. Tools and Supplies Used in Removing Old Stain and Varnish.

or a substitute in the form of a puttyknife or table-knife. Apply more suds and give the surface a thorough cleaning until all wood is exposed, whereupon

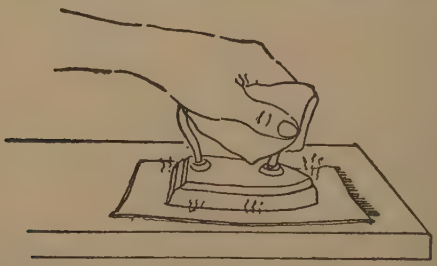


Fig. 128. Ironing Out a Bruise in the Polished Surface of a Piece of Fine Furniture.

wash it with clean water. It may then be restained and revarnished. (See *Fig. 127.*)

To Remedy Scratches in Woodwork and Furniture, apply a little lard oil or turpentine, rubbing

briskly with a rubbing felt or strip cut from an old felt hat. If the stain is off, touch up the spot with a similar color; when dry, apply a little shellac; when the shellac is dry, rub it.

To Remove Dents (*Fig. 128*), fold a piece of blotting paper three or four times; saturate it with water, allowing the superfluous moisture to drip away. Heat a flatiron to a laundry heat. Place the damp blotting paper over the dent, pressing firmly with the iron. This will "draw up" the indented wood to its normal position, if the bruise is shallow; if it is quite deep, it may be necessary to redampen the blotting paper and repeat the heating operation. Repolish the surface with oil and a rubbing felt.

XIV

INTERIOR REFINISHING

Refinishing the interior of a house, such as the doors, casings, floors, baseboards, window-frames, *et cetera*, presents quite a different problem than that of refinishing furniture or other movable woodwork.

In the first place, the woods used for interior construction are generally quite different from those employed for furniture building. Mahogany, walnut, birch, gum, and oak are the principal woods used in furniture. On the other hand, ash, fir, cypress, redwood, spruce, yellow pine, white pine, and basswood are the chief woods used in interior trim. It is true that all of the furniture woods named are also used in house-building, but only in the most costly of homes, for they are very expensive.

Two types of finish are employed in both finishing and refinishing the interior woodwork. These are what may be termed the transparent finish and the opaque finish.

A Transparent Finish is one in which the wood is made exceptionally smooth and then stained, in order to bring out the full strength and beauty of the grain. The stain coat is then protected by one or more coats of varnish, which gives a glasslike cover to it.

An Opaque Finish is one in which the wood does not have to be made quite so smooth, for paint or enamel is applied to it, which of course completely hides the grain.

The Kind of Finish to be used will depend a whole lot upon the kind of wood you wish to refinish. As a rule, very few people who have pretty furniture wood in their interior trim will ever think of covering up its beauty with a mantle of paint or enamel. Such woods should always have the transparent finish. But if you are tired of the particular shade of color so long identified with your oak or walnut, it is a very easy matter to change that shade to almost anything you may desire.

To Refinish with Varnish, where the old finish is not cracked or rough, all you need to do is to revarnish. If the old varnish has become checked, cracked, scaled, blistered, or badly scarred, and you are quite satisfied with the color it reflected when fresh, remove the old varnish and stain, restain with the same color, and then revarnish. The two methods named are about the only satisfactory ones that are available for renovating interior trim in a transparent finish.

To Refinish with Paint or Enamel, less trouble is experienced, for the reason that your coloring matter is right in the protective coating itself which you intend to use in restoring the life to the old coat. Just how you go about such a brightening up will depend considerably upon the condition of the old coat. If it is very rough, it should be entirely removed. This can be done with a scraper, aided by a washing with lye solution, or with some of the cleaning-powders put up in packages. Follow with a sponging off with clean water. Directions for applying the paint or enamel will be found in the next chapter.

Woods That Can Be Made to Imitate Others, by applying a suitable stain, are: For gumwood—white pine, basswood, poplar, redwood, birch, and walnut. For oak—ash and chestnut. These are all transparent types of finish, of course.

The Kind of Stain to be Used will depend upon the kind of wood and the shade to be produced. Acid stains are usually employed for gray effects and for fumed oak finish. Oil stains are better adapted to golden oak, Early English and kindred shades. Water stains should always be used for mahogany, walnut, birch, and gum, where the best effects are desired. Oil stains are sold for such woods, but they are not permanent and also cloud the grain to some extent.

The Varnish to be Used for interior trim should be carefully selected; purchased for the particular kind of situation it has to meet. For instance, for doors and window casings, where moisture sometimes gets in, a good waterproof varnish of the spar variety should be applied. For baseboards, stair railings, interior doors, and the like, which are always dry, a less expensive plain interior varnish is all right. For floors, a special floor varnish is to be recommended if you can afford it. If, on the other hand, you have a variety of "going over" to do some spring, and feel that you do not care to invest in more than one kind of varnish, by all means buy a spar varnish, as it is the best all-around coater made to-day.

The Paint or Enamel to be Used should likewise be carefully selected. Buy a good grade of a well-known manufacturer's output, even if it costs a little more; it always pays in the end. Choose it, too, to

match the surroundings. There are various paints and various enamels for various parts and things of the home. The following chapter will give you more complete information on the subject of painting and enameling.

XV

INSIDE AND OUTSIDE PAINTING

To a person who never has done it, painting generally appears to be the simplest work in the world. It really is quite an easy matter to spread paint on woodwork with a brush, after a little practice, but such things as the proper selection of the paint for the job in hand, and its application so that a good-looking, enduring coat will be the result, are features of painting which require more study.

Real painting depends chiefly upon a good under surface, a good paint, and the right drying conditions. These requirements are well within the possibilities of the average householder to produce. All he needs is the ability to absorb a few simple directions, a little money for his painting outfit (such as suggested in *Fig. 129*) and care and neatness in handling a brush.

When you consider that three coats of paint make a film only 8/1000 of an inch in thickness—or like that of ordinary writing-paper—it is obvious that, to give proper protection, the paint must be of the very best materials.

The Paint, therefore, should contain pure white lead or red lead, pure raw linseed oil, pure turpentine, nonfading coloring matter, and the best dryer. Under no consideration buy unknown brands of paints. Get only those that have a reputation, those that the dealer will guarantee himself, those that contain no so-called substitute turpentine.

Mixing Your Own Paint is to be recommended, where you find it impossible to get pure ingredients ready-mixed. Most professional painters mix their

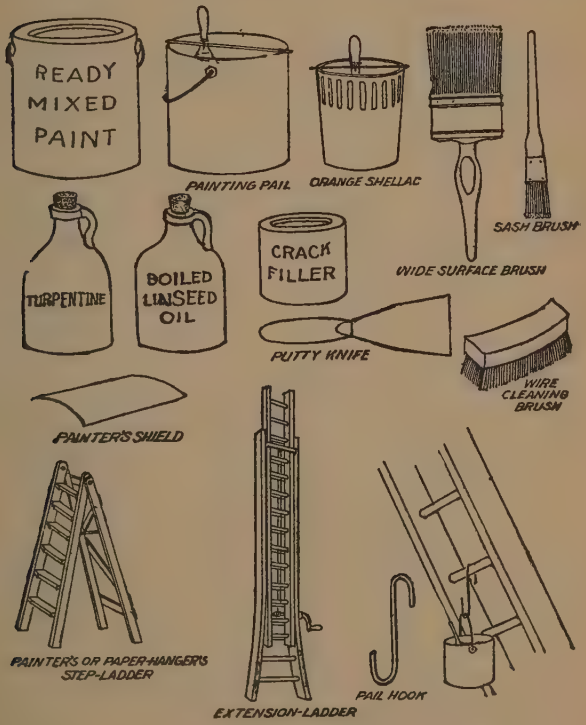


Fig. 129. Tools and Supplies Used in Painting.

own paint, not because they save money by so doing, but because their reputation hangs upon the lasting qualities of the jobs they do for people, and they sim-

ply do not care to take chances with ready-mixed compounds.

For an Outside Priming Coat, use 1 pound of red lead to 9 pounds of white lead, to 1 pint of raw linseed oil, to 1/16 pint of japan dryer.

For an Outside Second or Third Coat, use no red lead, 7½ pounds of white lead, 1 pint of raw linseed oil, ¼ pint of turpentine, and 1/20 pound of drier.

For an Inside Flat Priming Coat, mix the same as for an outside work, except that you omit the red lead, using that much more white lead; also use turpentine in place of the linseed oil.

For Inside Flat Second and Third Coat, use half as much turpentine and twice as much white lead as for a first coat.

Pour the oil, a little at a time, on the pigment (white lead or red lead or both), and stir briskly with a paddle. When the lumps are dissolved, slowly add the ground color that you prefer, until that is dissolved. Then add the dryer, stirring it in thoroughly.

Never thin paint with oil. The oil is a binding agent only—used for blending together the white lead and ground color. The turpentine is the thinning agent.

The Various Kinds of Paints may be roughly grouped under two general classifications—inside paints and outside paints.

Inside Paints contain less oil and more turpentine than outside paints. For this reason they dry proportionately faster. Inside paints cover a variety of special forms of paint. For instance, there are water-mixed paints, such as the calcimines and gypsum prod-

ucts, for painting the plastered walls and ceilings of the home; there are the flat oil paints, used for the same purpose; there are inside woodwork enamels—bathtub enamels, furniture enamels, stove-pipe enamels, floor paint, radiator paint, screen paint, and concrete paint. Each of these is especially well adapted to its particular use, and should be purchased ready-mixed rather than that you should attempt to mix them yourself, unless the paint is supplied you in dry form with a recommendation and directions from the manufacturer for home mixing.

Outside Paints contain a maximum of oil and a minimum of turpentine. For this reason they are comparatively slow to dry, but the oil gives them lustre and long life and an able defence against those relentless foes of all outside paints—moisture and sunshine. In addition to the base of oil, most paints designed for coating metal also contain a graphite binder, which preserves their lead base against oxidization from rust. If you have, therefore, such metallic things as eavestroughs to paint, be sure to secure a graphite paint.

Outside paints comprise the following special preparations: House paint, barn paint, roof paint, porch floor paint, boat paint, eavestrough paint, iron paint, auto paint, auto enamel, bicycle enamel, and carriage paint.

When to Paint Your Home, inside or out, will depend entirely upon the condition of the old paint. In this connection, it will be well to remember that paint serves two purposes; one of these is that of a beautifier, the other is that of a preservative or protector of the surface beneath. On inside work the

beautifying element predominates; on outside work the protective feature is most valuable.

Therefore, the frequency with which you should repaint your interiors will depend entirely upon their color and condition values in your own eyes. If a room becomes a little shabby, and shabbiness is something you cannot stand, it should be repainted immediately, for your own peace of mind. If it is not shabby, but you have tired of the color or the style of finish, your peace of mind will again have to be satisfied by a change.

With exteriors it is another matter. Here adequate protection against the weather must be provided, for economical reasons regardless of æsthetic values. Inasmuch as this is a practical situation, one governed by natural laws, practical rules can be fitted to it. It may be said, therefore, that the outside of every house should be given one fresh coat of paint every year or at least two coats every second year. In the long run this is a paying investment, and stuck to, will give you not only an always fine-looking home but one which will be preserved to the uttermost of years.

If you cannot bring yourself to this frequency of painting, you should at least paint your porches every season, for on them the rains and snows find greatest lodgment and there is also considerable wear from human feet and porch furniture.

Selecting Colors is sometimes quite a problem for the home-owner. This is because his experience is not very broad in this matter, and sometimes his taste is not very good and not very positive.

As a rule, a house situated in the country, or in the

suburbs of a city, surrounded by foliage, should be painted white or in some of the lighter tints, such as the grays or buffs. Greens and other dark shades are too melancholy for houses amid trees, although they make excellent trimmings for the light-colored body.

In the heart of the town or city, where neighbors are close and factories also close, darker body colors are recommended, such as the grays, yellows, browns, and greens, with their various intermediate tones. The smoke from chimneys and the dust from the streets will soon muddy white and pearl finishes.

Low and rather small dwellings can be made to appear larger and more dignified by the use of the lighter tones, and this effect can be further emphasized by painting the house in one solid color, without any special trimming tone.

Colonial types of homes appear better in the lighter colors, such as white, cream, pale yellow, and pearl gray.

For inside painting, paints should be selected with equal care for their tonal values.

As a rule, kitchen walls and ceilings should appear in light buff, cream, medium buff, or tan. Either paint or enamel can be used, to suit. Enamel wears better, looks better, and washes better. The floors can also be enameled or painted, as desired, the enamel giving the greater degree of gloss and a somewhat more permanent wearing quality on account of the varnish gums contained in it. Here various shades of yellow, brown, gray, and green, are to be preferred.

For bedrooms, walls and ceilings of white, pale blue,

old rose and pea green will look pretty. Avoid enamels, and use a flat wall paint. The floors may be enameled.

For bathrooms, white is the most popular paint, as white is symbolical of cleanliness, and as, furthermore, it matches the usual bathroom fittings in color. Where a little color is desired, light blues and greens are permissible.

Dining-rooms, living-rooms, and halls, if painted, should have their walls and ceilings done in a flat, tinted color, with the ceilings a shade lighter in tone. Here decorative effects are very pretty if worked in as borders in harmonious tints made through stenciled patterns. In fact, such effects can be applied to bedrooms and bathrooms with splendid results if the workman or workwoman is sufficiently artistic.

Most people who do their own painting fail to get a satisfactory result more because of a poorly prepared under surface than for any other reason. It is well to remember that the surface painted upon simply *must* be in a smooth condition if you are to expect a smooth finishing coat. While paint will fill up very small crevices and indentations in plaster and wood, it will not efface large ones.

Preparing the Surface, therefore, is an important step in the process of painting, either for inside or outside work.

To fill cracks or openings of large size, occurring in woodwork, the best plan is to work out pieces of wood and glue or brad these in place. To fill smaller cracks, buy a can of crack filler, which is especially put up for this purpose. Directions for applying the filler are

given on the can. It is a heavy mineral paste, is worked into the opening with a puttyknife, scraped down flush, then allowed to dry until rock hard, whereupon the paint may be applied.

To fill cracks and holes in plastered walls, go to your painters' supply store or hardware and get a can of plaster cement or plaster filler, as it is variously termed. Apply this according to the directions on the can. Another way is to secure a little plaster-of-Paris at the hardware or drug store, mix this with sufficient water to form a heavy paste, and fill the cracks immediately, before the paste has a chance to harden, for it hardens rapidly.

Smoothing down the surface to be painted is next in order. If the old paint is rough or scaled, it must be gone over with a painter's wire brush or a scraper until the worst parts are leveled, then given a further smoothing with sandpaper (about No. 1) or medium-grade steel wool. Where old paint is too far gone to smooth down in the way stated, burn it off with a gasoline-torch.

Finally, the surface must have a good cleaning. By this I mean that every bit of soot, grease, and other kind of dirt must be removed, for fresh paint will not stick to any place containing such deposits. Use a solution of laundry soap and water, or water and washing-powder, for the cleaning, then wash off with clear water, and allow the surface several hours to dry before applying paint.

Where the old paint is smooth and glossy, as is frequently found under the cornice, or similar places protected from the weather, it is a good plan to roughen

the surface by sanding with No. 1½ paper, as this helps the fresh paint to grip the old better.

Brushes of the right kind are a prime requisite. The bristles should be long, uniform and elastic, firmly set in cement or rubber so that they will not loosen and pull out. A brush 3 or 4 inches wide should be used in painting siding and other equally broad surfaces. For the smaller work, such as painting window-sash, a regular 1-inch window-sash brush is recommended.

If possible to avoid it, never dip the bristles of the brush more than half-way in the paint. To get the paint up into the closely knit head of the brush means the hardest kind of work later on to clean it out, besides which a surplus of paint in the brush is bound to drip on the hands and clothing of the painter, if not upon a previously painted surface, making a sloppy mess. Nowhere in the painting process are neatness and care required more than in dipping-in.

Of course there will be times when it will be inconvenient for you to hold the brush—times when you must set it down for a moment or more. Upon such occasions either lay the brush horizontally across the rim of the paint pail, across two strips of wood placed upon an old newspaper, or suspend it in the paint by means of a wire hook over a wire rod reaching across the pail rim. (See *Fig. 129.*)

During intermissions between painting operations, such as when you are away at lunch or spending the night in sleep, it is not necessary to clean out the paint brush. Just keep it suspended in the paint, bristles at least half covered, else suspend it in clear water or turpentine. When going to work again, after the brush

has been in turpentine or water, be careful to squeeze out all the liquid you can before immersing it in paint.

To Clean a Paint Brush, place it on an old newspaper or in a shallow dish. Pour on turpentine or kerosene and then gently pummel the bristles up and down or squeeze them with a blunt stick. Wipe off the brush with waste or a rag, then give it another soaking in the cleaning liquid, repeating the wiping and drying.

Never lay a brush away with paint in it. It means the ruination of that brush, for, when the paint gets rock hard, it is impossible to remove it all without disastrous results to the hair. The good painter always makes it a point to clean out every one of his brushes as soon as he is through using the color into which they have been last dipped. After cleaning, wrap the brush in paper, ends folded over, and snap a rubber band around it.

Stirring the Paint thoroughly will have much to do with the success of your painting job. Whether you have mixed up your own paint or are using the "store" variety in cans, do not neglect to give it a good stirring before and during the coating process.

Before opening a new can of paint give it an energetic shaking. After removing the top of the can, pour off into another vessel at least two-thirds of the oils that have risen above the pigment. Stir the pigment and remaining oil with a strong, smooth paddle, working from the bottom upward and scraping the paddle along the edges so as to loosen and dissolve every particle of pigment. When all lumps have been reduced and the liquid is of a uniform consistency,

begin to pour back the removed oils, a little at a time, while you stir constantly. Then "box" the paint, which is a professional term meaning to pour it back and forth, for about a dozen times, from one pail to another, each time leaving about one-fourth of the paint in the pail which is being emptied.

The paint should also be stirred from time to time as it is being used.

It is not a good plan to paint directly out of the can in which you buy your paint. Use a 2-quart tin pail, and never fill it more than half-full. This sort of vessel is easy to hold in the hand, easy to suspend, safe to set down, and readily accessible to the widest brush.

The Amount of Paint Required can be figured out with reasonable accuracy, much depending upon the quality of the paint used and the condition of the surface to be coated.

To ascertain the amount of paint needed for covering the outside of a building:

Measure the entire distance around the house, not neglecting the angles. Multiply the result by the height from sills to eaves. Set the total number of feet at one side of your paper, in a total column.

If there are any gables, multiply their width by half of their height. Set the result in the total column.

Figure railings and spindle work as if they were boarded up solid and had to be painted on both sides. Secure the total.

Multiply the total running length of the overhanging eaves and cornices by the width. Set down the total.

Make no allowance for doors or windows, as the

casing and sash must be painted, in addition to which some paint is required for the edges of the weather boards, thus making an approximate balance.

After determining the total number of square feet, divide by 250. The result will be the number of gallons required for 2-coat work.

EXAMPLE:

Front	30	lin. feet
One side	45	lin. feet
Rear	30	lin. feet
Other side	48	lin. feet
Total	153	lin. feet
	x20	height
Total, body	3060	sq. feet
Gables	25	sq. feet
Railings	15	sq. feet
Total surface	3100	sq. feet

3100 ÷ 250 = 12.6 gals., 2 coats.

Knots and Pitch-pockets in lumber are the worst kinds of groundwork for paint unless they are especially treated. Wherever, in new work, you find a knot or a streak of pitch, give it a couple of coats of orange shellac, to seal up the pores and prevent the pitch oozing out when the hot suns come. Unless you do this, the paint will blister and scale off. If an entire board seems full of pitch, shellac it all, else burn over the surface with a blowtorch.

The First or Priming Coat in new work serves as the foundation for the coats to follow. It should, therefore, be applied with much care and consideration. Should the new wood be green and damp, it is best to

apply the priming coat and then allow three or four weeks for the wood to season, before putting on the other coats. This should also be done when painting plastered walls, if the plaster has not fully dried out. The priming coat is produced, if you do not buy a primer ready-mixed, by taking about 1 part of white lead, ground in oil, and thinning it with 10 parts of raw linseed oil, in which is put one tablespoonful of dryer to the gallon. Brush it well into the wood.

White pine is a normal wood that takes and holds paint well. Cypress, however, is very oily. If a primer suitable for white pine—that is, a primer rich in raw linseed oil—is used on cypress, it will not penetrate the wood, and, therefore, will not hold the paint as it should. But if you will prime your cypress with a mixture of two quarts of pure turpentine and a quart of raw linseed oil, to a gallon of ready-mixed paint, you will have no trouble at all. For redwood, cedar, or similar porous softwoods, each gallon of paint should be reduced with 1 gallon of raw linseed oil and 1 quart of turpentine.

After the priming coat is dry, say the second day, sandpaper it lightly with No. 1 paper; dust it off, and then putty up all holes and cracks. Next, apply the second coat. If this is the last one you intend to put on, use the paint just as it comes from the store. If, however, you plan to have three coats, reduce the store product by adding ½ pint of turpentine to each gallon of paint. Let this dry two days, then apply the third coat just as it comes in the can, without any thinning.

The Time to Paint is when the weather is warm and dry, with as few insects flying about as possible,

as they are sure to stick in the paint if they ever touch it. From all points of view, the best painting season for outside work is late spring and early fall. Inside painting, of course, can be done almost at any time, providing the temperature is kept right—about 70 degrees.

In the morning, paint the west portions and other shady parts of the house. In the afternoon, paint the east sections. This plan keeps the hot sun off the work and prevents "tears" of paint caused by excessive heat. It also prevents the painter from becoming nauseated from paint fumes.

The Time Not to Paint is in damp, rainy, foggy, or frosty weather—for oil and water will not mix. If the wood is damp, or if water gets into your coat before it dries, a streaky, speckled, poorly-set coating will be the result, and the paint will eventually blister and peel. Therefore, allow plenty of time for damp surfaces to dry out before applying paint to them. If it looks like rain, and you have an outside job on, do not paint that day.

Inside Painting Hints

Thin Paints with Turpentine, when doing inside painting; be sure to use the genuine turpentine, not the substitute.

To Paint Plastered Walls which have never been painted or papered, first repair any broken places with plaster-of-Paris, and smooth down the fillings, when set, with sandpaper. Then apply a coat of glue-water, using about two handfuls of glue chips to the pail of

water and dissolving with heat. When it is dry, apply a thin coat of paint, followed by a heavier coat.

Walls and ceilings are usually finished in a gloss paint. This should be thinned with raw linseed oil rather than turpentine.

Window Sash is not difficult to do if you are

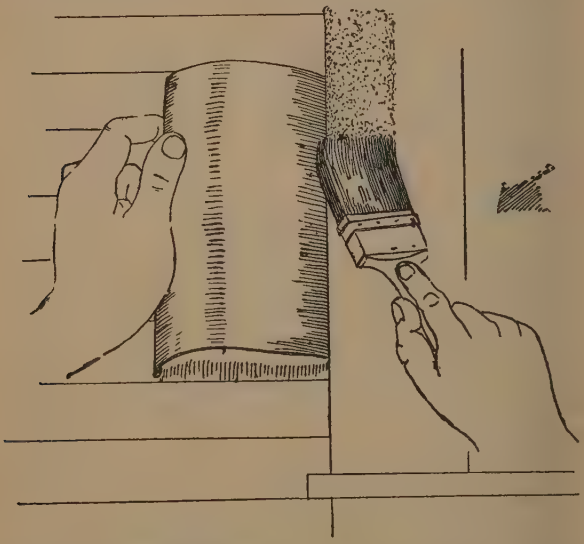


Fig. 130. Using the Painter's Shield on a Window Frame.

careful in handling the brush. First wash the glass and sash, and use an ordinary paint mixture, applying it with a standard sash brush. To prevent paint getting on the glass, use a painter's shield, such as shown in *Figs. 129* and *130*. This can be made from a piece of scrap tin or galvanized iron. Bend it into a concexity, as illustrated.

Should paint get on the glass, wipe it off immediately with a cloth dampened with turpentine. If the paint dries on, remove it by scraping with a puttyknife or old caseknife.

Protect floors by spreading out old newspapers.

Begin above, then work downward.

A stepladder makes the best platform. If you can't get one, use boxes with a board across, or a wood-bottom chair.

Enamel Coatings must be "built up." That is to say, the surface you are to enamel must be covered first with a plain opaque paint called enamel undercoater. This undercoater should be tinted to match the color of the enamel. The latter is applied in a warm room, and is brushed on just like varnish. Use a fitch or ox-hair brush, as a bristle brush, such as used with common paint, is too stiff. Put on two or three coats, smoothing each coat with sandpaper when dry, and letting it stand at least three days between coats.

The Basement or Cellar can be made quite as attractive and habitable as any other part of the house if you will give it two coats of concrete paint, which can be bought in a variety of pleasing colors. This will keep down dust and make your basement bright, cheerful, and sanitary. Before applying the paint to the floor, wash the floor thoroughly with a hose or sponge, and let it dry well.

The Furnace and Radiators, piping, hot-water heater, and other metal conductors of the home can be made to look far less offensive, as well as made to last longer, if you will give them a couple of coats of

iron paint of a becoming shade, or treat them with aluminum paint.

Stippling is the process of giving to walls or ceilings a painted surface resembling high-grade wall-paper. A background or foundation color of some flat wall paint is applied and permitted to harden. Over this is laid a contrasting color of similar paint, applied much thicker. This coat is then roughened into whorls, while it is still wet, by twisting in it a wad of cloth held in the fingers.

Outside Painting Hints

I have already told you what kinds of paints to use in outside painting, how to prepare the surface, and when to paint. Under the specific heading at the beginning of this section, I will give you some additional information on outside painting.

The Paint is of paramount importance. If there is any secret to good painting it lies in the practice of using much oil in the paint, for it is an old axiom in the paint shop that "oil is the life of paint." A thin mixture in which raw linseed oil predominates will last much longer, as a coating, than a heavier mixture containing more pigment and less oil.

If a paint contains no more than one-third of zinc-white to two-thirds of white lead, it will have a very well balanced proportion of pigment. More zinc-white will prove a damage to it, causing it to scale; less, will render it not so hard or durable. At the ratio named, these pigments unite to make a better paint than either would be if used alone with oil as a binder.

Preparing the Surface is the first task. In repainting a frame house, scrape off or burn off all loose old paint, then thoroughly dust, removing all spider nests, cobwebs, dirt, and other foreign matter. If any of the window- or door-glass needs replacing, take care of that need, suggestions for which will be found in Chapter XI. See that all broken-out pieces of putty are neatly replaced with fresh putty.

The Priming Coat should have plenty of oil, although not as much as when first-coating new work. Work it well into the old paint. The second and third coats should be somewhat heavier in pigment.

To Reach High Places you will need at least one good ladder. If the gables are very high, an extension type of ladder (see *Fig. 129*) will probably be required. A stepladder will also be needed for lower sections.

To Handle a Ladder Alone, lay it flat upon the ground, with the foot against a fence or other obstacle. Go to the other end of the ladder, raise it over your head, and walk forward, changing rungs from hand to hand. When the ladder is at a perpendicular balance, grasp it firmly, one arm down and the other arm up, and carry it to the position desired. Then, getting between it and the house, let it gently slant until its top rests against the building. See that its lower end rests evenly and firmly upon the ground, so that it will not slip.

Sometimes a ladder cannot be used from the ground, in painting a gable or a siding, because a porch or shed interferes. In such cases, it is generally possible to place a short ladder directly upon the roof of the

porch or shed and thus reach the desired working section. To insure the foot of the ladder from slipping, nail cleats to the lower roof.

To paint the lower reaches of a high gable, from a lower gable roof, lay the ladder along the lower roof and cleat it there. You can then sit on the rungs, secure in all positions, while you do your painting.

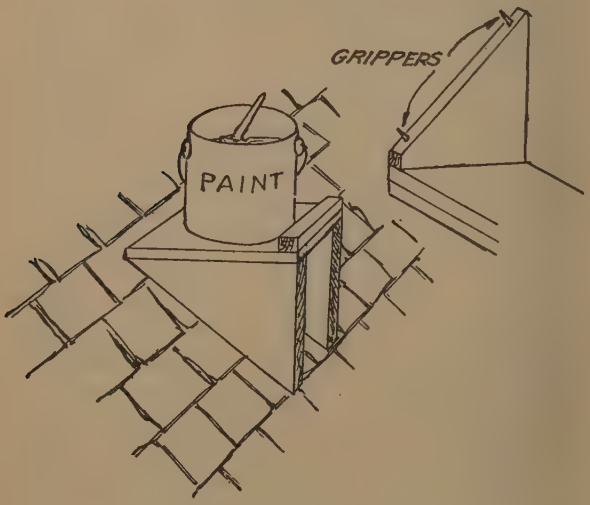


Fig. 131. A Home-made Pail Saddle.

A Paint-Pail Saddle (*Fig. 131*) is a handy device in such a position. It consists of two tapered ends connected by a shelf or top board, the latter having a small cleat in front to keep the paint pail from sliding off. In turn, the framework is kept in position on the sloping roof by protruding nails, ends sharpened, which

act as grippers. This convenient little article can be made in a few minutes out of scrap lumber.

A Paint-Pail Support for a Ladder (*Fig. 129*) is easily made by forming bends at both ends of a heavy piece of wire. The pail bail rests in one hook, while the other hook engages a rung of the ladder. As you work lower, change the position of the hook.

Wear heavy-soled shoes if you have to stand long at a time on the rungs. Thin soles tire the feet.

If you have no overalls to slip on, at least paint in an old suit, for you are sure to get some paint upon your clothing.

The Place to Begin Painting is at the highest point. Then work downward. In other words, paint the cornice first and finish with the wainscoting. Windows, doors, and porches come last.

Be careful not to let your ladder mark up a freshly painted surface. To prevent this, do not slide the ladder along the wall when moving it, but carry it free of the surface to the new place where it is to rest, then let it down gently.

Between painting periods keep your brushes suspended in the paint pail, and the paint covered.

To Remove Paint from Your Skin, use a good washing-powder and plenty of soap and water. Turpentine or kerosene will also loosen fresh paint, but should be kept off the face.

XVI

WALLPAPER HANGING

WALLPAPER is capable of hiding an unsightly wall as no other form of decoration can. Moreover, it possesses the advantage of decorating a room in a quick, inexpensive, and attractive manner.

Where the plastered surface is fairly good, a better job of papering can be done than where it is rough. For this reason, it behooves every householder who is inclined to do his or her own paper-hanging, to put walls and ceilings in as smooth a condition as possible, just before applying the paper. The manner of doing this will depend on whether or not the surfaces have been papered.

To Condition New Walls and Ceilings, fill all cracks with prepared wall plaster or a plaster-of-Paris composition; then wash the surfaces with soap and warm water, to remove all grease, dust, and dirt. Follow with a sponging off with hot alum water or formaldehyde, which will destroy vermin and sweeten the plaster.

When the walls are dry, apply a coat of glue-size. This size can be made by stirring up 4 ounces of white glue to every 2 quarts of water, having the water hot. Apply the mixture hot, also. This will fill the pores in the walls and ceilings, and it makes a hard, smooth surface for the wallpaper to meet.

If the walls have been calcimined, wash off the coating of calcimine with warm water.

If the walls have been whitewashed, apply a thin sizing of corn starch, alum, and glue. This will dry rapidly. In a few minutes the whitewash will begin to curl up; then sweep it off with a stiff brush.

To Condition Old Papered Walls and Ceilings, you must first make a close inspection of the old paper, to note whether or not any of it must be removed before applying the new. If there is but one coating of old paper, and this is not loose, you can repaper directly upon it. But if the old paper happens to be

Fig. 132. Removing Old Wallpaper.

thick, consisting of two or more layers, every bit of it should be removed, no matter how well stuck down it may appear, for it is quite sure to crack and break off with the weight of more paper added to it.

Do not tear off loose paper in spots and then repaper over it, for the new job will be a bumpy-looking one. It is far better to remove entirely the old layer of paper. To do this, first pull off all you can. Remove more by "chiseling" it off with a puttyknife or case-knife. Soak and scrape off the remainder. (See *Fig. 132.*)

Lineal feet of Walls	*Height of Room* 8 ft.	9 ft.	10 ft.	*Ceiling Rolls*
18	5	5	6 rolls	1
20	5	6	7 rolls	1
22	6	6	7 rolls	1
24	6	7	8 rolls	1
26	7	8	8 rolls	1
28	7	8	9 rolls	2
30	8	9	10 rolls	2
32	8	9	10 rolls	2
34	9	10	11 rolls	2
36	9	10	11 rolls	2
38	10	11	12 rolls	2
40	10	11	12 rolls	2
42	11	12	13 rolls	2
44	11	12	13 rolls	2
46	12	13	14 rolls	2
48	12	13	15 rolls	2
50	13	14	16 rolls	3
52	13	15	16 rolls	3
54	14	15	17 rolls	3
56	14	16	17 rolls	3
58	15	16	18 rolls	3
60	15	17	19 rolls	3
62	15	17	19 rolls	3
64	16	18	20 rolls	3
66	16	18	20 rolls	3
68	17	19	21 rolls	3
70	17	20	22 rolls	3
72	18	20	22 rolls	4
74	18	21	23 rolls	4
76	19	21	23 rolls	4
78	19	22	24 rolls	4
80	20	22	25 rolls	4
82	20	23	25 rolls	4
84	21	23	26 rolls	4
86	21	24	27 rolls	4
88	22	24	27 rolls	5

Wallpapers, for the most part, are put up in double rolls, and estimates are based upon a single roll

of 8 yards length and 18 inches width, although some of the cheaper papers run in lengths as low as 7 yards. Ingrains, plain duplex, and crepe papers contain 3 single rolls to the bolt, 30 inches wide. Most 20-inch papers come 2 rolls to the bolt. English paper runs 21 inches wide, 12 yards to the single roll. Japanese paper is 12 yards long and 36 inches wide. The French papers vary, but usually run 9 yards long and 36 inches wide.

Choosing Wallpaper is not the simple task some people would believe it. It makes a decided difference to you what color is on the walls of the room which you are in most of the time. If you do not believe this, try living for a week in a room that is papered in dull purple. The experience will make you so morbid that it will drive you almost wild. A person who lives in a room papered in deep red or brilliant red will, in most cases, be excitable, irritable, and quick-tempered. The same person in rooms papered in yellow, the color of sunshine, will wax cheerful and contented.

Highly nervous, imaginative people are better off in rooms papered in gray-green, with no distinct pattern visible. Not long ago a woman of this temperament called at a store to buy some wallpaper. In every pattern shown her, she traced some fancied resemblance to a human face or an animal. In one case she distinctly saw a spider—an insect that always gave her the shudders,—although neither the proprietor nor his two clerks could see it. In another pattern she detected an ugly human profile, of which the dealer could trace a very faint likeness when she pointed it out.

Thus a wallpaper that suggests unpleasant images is actually harmful to people of this type; there are many men, women, and children who will be disagreeably affected by it.

Invalids sometimes go almost into hysteria trying to count the stripes and figures in wallpaper. For this reason hospitals and sanitariums have plain walls.

But the normal person prefers a paper that has a design of some sort. It may not be very pronounced, but a distinct and pleasing pattern it must be.

If you don't like the room in which you spend most of your time, study it carefully. Is the ceiling decidedly lighter in tint than the walls? If it is heavier or darker, more distinct in pattern, or if it seems darker because of the lighting of the apartment, you are quite likely to have a sense of depression, as if something were weighing you down. As a matter of fact, you are trying to *lift off* that heavy color or pattern. Ceilings should always be lighter in color than walls, and less distinct in pattern, if any pattern is used.

If you are living in small rooms and seem to feel the walls closing in upon you, beware of bright colors and large patterns. Choose papers with cream or other light backgrounds and small patterns. These will seem to enlarge your rooms.

If the rooms are lofty, beware of stripes, as these will make the rooms look even higher than they really are.

In rooms that are chill and unfriendly, use bright colors and large patterns. Such papers will make the walls come closer and will erase the old lack of cheer.

When the ceiling is so high that you have a sense

of distance and loneliness, run the ceiling paper down several feet to a molding or border. It is easy to fool your eye, and you will respond to that deceit.

If your ceilings are low, try striped paper—rather narrow stripes in a small room, broader ones in a large one. Stripes exaggerate the height of a room and may be run approximately right up to the ceiling, with only a 1-inch border at the top.

Should you have a north room, introduce the sunshine by giving it a yellow background. If you do not care for yellow, rose is the best substitute. In a room that is too well lighted, use grays, greens, and tans.

The most popular papers to-day are those which are blended effects of soft gray and tan backgrounds, with suggestions of rose and blue and green worked in patterns which, as far as the eye can see, are no patterns at all, but which the artist who designed them plans for a very definite outline. Impressionistic effects are the rule. Such papers are sold all over the country for living-rooms and dining-rooms and halls. In cities they are also used extensively in bedrooms; but in suburban districts, patterns seem to be preferred for bedrooms.

"Drop" and "Straight" Papers are wallpapers having figures exactly opposed to one another from a hanging point of view. Therefore, before attempting to hang any figured paper you should carefully note which class of material you have. In drop patterns, the figures will not come immediately opposite, but adjacent strips will have to be moved either up or down half-way between figures to bring about this result. Straight paper has figures exactly opposite

each other, when the strip ends are even. Again, drop styles have complete patterns on them, and you cut *between* the dots printed along the margin and match accordingly; while straight styles are cut *on* the dots.

To Save Paper, when you have a drop pattern, cut from two different rolls, cutting on the dots of one roll and between the dots of the other.

The Place to Buy Wallpapers is either of your local merchant or of some of the outside big mail-order houses. As a rule, it is advisable to deal locally, because you can see all the display of patterns in the full-sized roll. However, it is likewise quite safe and convenient to go outside for your papers, as most of the mail-order concerns are glad to send out free samples of all the patterns they handle, and you can examine these in your own home entirely at your leisure.

Prices run from 4 cents a single roll up to 50 cents or more. Borders are sold by the lineal yard and bring slightly reduced prices.

The Best Time to Paper is in the spring and fall, because these are the seasons for general house-cleaning. However, where rooms are well heated, paper may be hung no matter how cold the weather outside.

In the soft-coal burning districts it is a poor home that does not have some room repapered every year and the whole house done over at least every three years. In cleaner districts bedrooms are repapered every two or three years and the living-rooms about once in every five years.

Hanging Wallpaper Upside Down might seem a joke to be taken seriously only in the comic papers. But it is often done by amateur paper-hangers. I

don't know how many different times I have been in homes where such a blunder had been committed and never noticed. I have seen flowers blooming downward, and even birds hanging to the bottom of a branch. Daisies, of all flowers, look queer when turned the wrong way. Borders are often reversed, and the tenants are unconscious of the fact, although they frequently state that they "never did exactly like that paper."

This lack of understanding of pattern seems odd in view of the fact that the eye travels naturally from the floor to the ceiling. Anyone who remembers this point will surely get his patterns right side up. Many paper manufacturers provide against error in this regard by printing on the margin an arrow indicating the top of the pattern, yet some people still persist in being "contrary."

Cleaning Old Paper is quite a tiresome task, but many men and women prefer to do it—where the paper is not too far gone—in order to save the immediate expense and trouble of applying a new covering.

Where bad blemishes occur, the best thing to do is to paste neatly over the torn or defaced portion a patch of similar paper, being careful to match the figure. Smaller blemishes can usually be "worked up" by skilfully applying a little water color or crayon.

Grease and dirt, the most common enemy of wallpaper, can be eradicated to a large extent by rubbing the surface with a small cotton sack in which is bran or oatmeal, slightly dampened. Professional paperhangers usually use a sort of dough, which may be bought, ready-made in cans, at a nominal cost.

A Wallpaper Cleaner can be made at home by using the following formula:

Salammoniac, 1 part.
Rye flour, 4 parts.
Water, sufficient to make a dough.

A Good Paste Formula is as follows:

To make up one pail of paste, take 2 pounds of flour; pour on lukewarm water to form a stiff batter; beat out the lumps with a broad paddle; pour on some boiling water, stirring briskly. When the mass has become swollen and has changed color, stop adding the hot water; pour in cold water to bring back the desired consistency, and let the entire mass get cold. It is then ready to use.

If you prefer to buy your paste ready-made, very convenient pails of it can be purchased of most wallpaper supply houses. Or you can buy cartons or sacks of specially prepared paste flour for 10 cents a pound, and all you will have to do to convert it into a good non-souring paste is to add cold water to it and stir briskly.

Tools and Equipment required for paper-hanging are shown in *Fig. 133*. Aside from the paper and paste, you will need, perhaps, a paper-hanger's paste brush, smoothing brush, old pail for paste, puttyknife and sponge for removing old paper, scissors, sharp knife (or regular trimmer), straight-edge, yardstick, plumb-bob, chalk-line, seam roller, extension pole for inserting in paste brush when doing ceilings, and some sort of ladder or other means of elevating yourself when you wish to reach the ceiling with your hands.

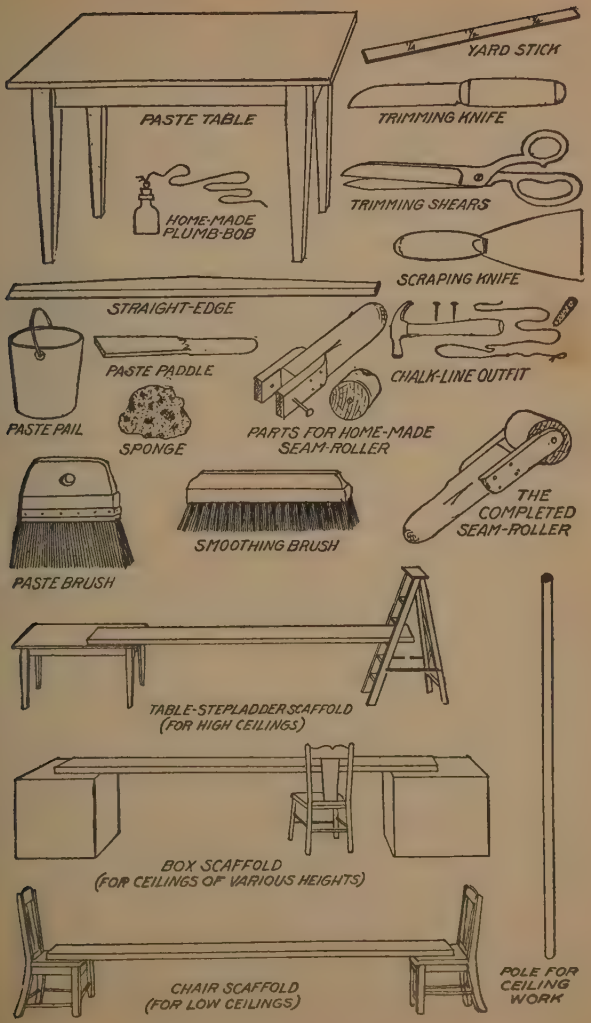


Fig. 133. Tools and Equipment Used in Paper Hanging.

The Plumb-bob can be made at home out of a bottle or similar weight to which a cord can be attached.

The Straight-edge can also be made at home, if you have a saw and plane. It should be about 7 feet long, 4 inches wide at the middle, tapering along the back to ends 1½ inches wide. The front edge should be true and beveled.

A Seam Roller can be bought for a small sum, although a fairly good one is easy to make by whittling out two brackets, nailing these to the end of a short length of broom handle, as shown in *Fig. 133,* and then inserting a short piece of wooden curtain pole for a roller. The latter should have a hole bored through it, before inserting the nail axis, so that the roller will revolve freely.

A Combination Folding Stool and Stepladder is to be found in many modern homes, and will prove useful to stand upon when hanging borders or ceilings. A common stepladder can also be used. But about the best arrangement in this respect is to lay a wide plank across two empty packing boxes, or from a ladder to a box or table, or across two chairs, if the ceiling is not too high. (See *Fig. 133.*)

You will need a kitchen table on which to cut, trim, and paste your paper.

A Pair of 10-inch Shears are best for the trimming, although somewhat smaller household shears can be used in a pinch. Two pairs are better than one pair, for then you can have one pair where you are hanging the paper and the other tool on the table; if you have only one pair, you must either carry them

from table to work with you, in your pocket, else have an assistant ready to hand them to you whenever you need them.

The Smoothing Brush is for working out the wrinkles in the paper the moment you have put it in contact with the wall or ceiling. Never dip it in paste, nor get it soiled, for an unclean brush will mark your paper. If you cannot afford to buy a regular paper-hanger's smoothing brush, use a clean, wide paint brush.

To Prepare the Paper for Hanging, take the roll in your left hand, and with the right hand unroll it to about the length you require. This length can be ascertained by previously using a tapeline, and placing a slight mark on the edge of the table as a guide.

Arrange the paper very carefully, so that you will not risk hanging it upside down. A good guide in this respect is to remember that all American papers are rolled so that the end where you begin to unroll is the top. English papers are the reverse of this.

In Cutting, take off at least half enough strips to cover the room.

The Pasting is done upon the table, with the face side of the paper down, of course. Be careful to smear as little paste as possible upon the table, as you work along the edges of the strip, for such surplus is likely to get upon the face side of the next strip you lay down. If paste does get on the table, it is best to remove it right away with a damp cloth.

When the strip has received its coating of paste it must be carefully folded so that you can carry it without tearing to the spot where it is to be applied. To

do this, arrange it as shown at *A*, *B*, and *C* of *Fig. 134*. This brings paste against paste and pattern against pattern. See that the edges are even, then carefully trim them, throwing the sticky trimmings in a basket at one side. Under the bottom of the folded strip place a piece of broomstick (see *C*, *Fig. 134*). Grasp the stick in the middle, and you will then be

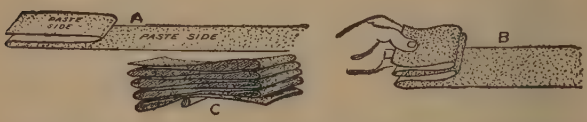


Fig. 134. How to Fold and Support Freshly-Pasted Wallpaper.

able to carry the strip easily to the scene of hanging without danger of tearing it.

To Hang the Ceiling Paper, start in that corner of the room which will allow you to work toward the strongest source of light, so that the lapped edges will show least.

Sometimes paper is hung without any border. In such a case, start your strip with a lap down the side wall sufficient to meet the molding line, and previously mark out such a line by using pencil and straight-edge or by snapping a chalk-line. To perform the last-named operation, drive a small nail at either corner of the room, at the desired height; fasten a chalk-line tautly between the nails; rub a little blue chalk on the under side of the line, then pull it outward near the center and let it snap back against the wall. This will leave a straight blue line along the entire wall. (See *Fig. 135*.)

If there is to be a border, allow only an inch or two lap down the wall. Supporting your folded paper upon its stick in the left hand, catch the smoothing brush under the first or topmost section, and firmly press the end of the strip to the wall. Then bring your brush slowly toward you, while you step backward and un-

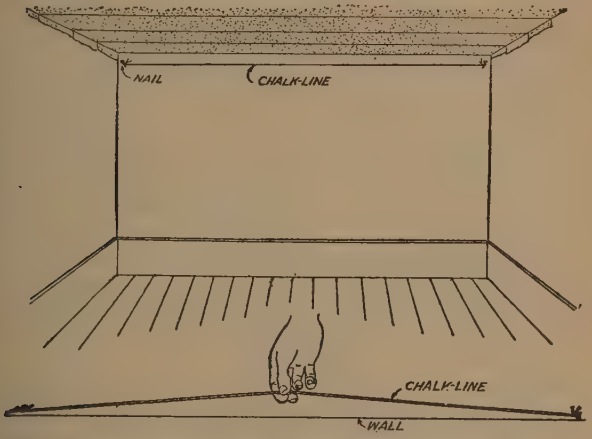


Fig. 135. How to Snap a Chalk-line Along the Walls.

fold the paper by so doing. Keep a constant watch to see that the edges are running true and that the paper is being pressed out flatly as you retire toward the opposite side of the room. If, at the farther end, the strip proves to be too long, as it very likely will, pull out your shears and trim its end to correspond with the drop of the first end.

In hanging the second strip, and those succeeding, the same method of operation is gone through, except that now you will have to match your right-hand edge

in a uniform lap (see *Fig. 136*) with the left-hand edge of the preceding strip, and see, when you start out, that the pattern agrees. In addition, you will have to

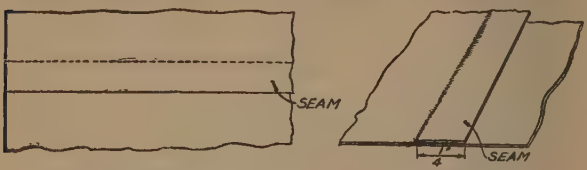


Fig. 136. Making a Seam in Wallpaper Hanging.

go over the seam with your seam roller, as soon as you have put the strip in contact with the ceiling. Roll with a firm pressure. The flatter you can make your

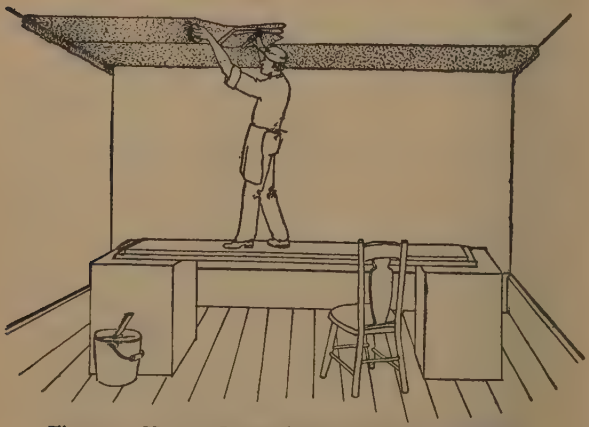


Fig. 137. How to Hang Ceiling Strips of Wallpaper.

seams the less they will show and the more artistic the job. *Fig. 137* very clearly shows the manner of hanging a ceiling as described.

To Hang the Walls, paste and fold the paper in the same manner as for a ceiling, allowing a little extra length. Start in the darkest corner of the room, at a window or door, and see that the first strip is hung plumb, which can only be done by using a plumb-bob, as shown in *Fig. 138*. Let this hang down from a

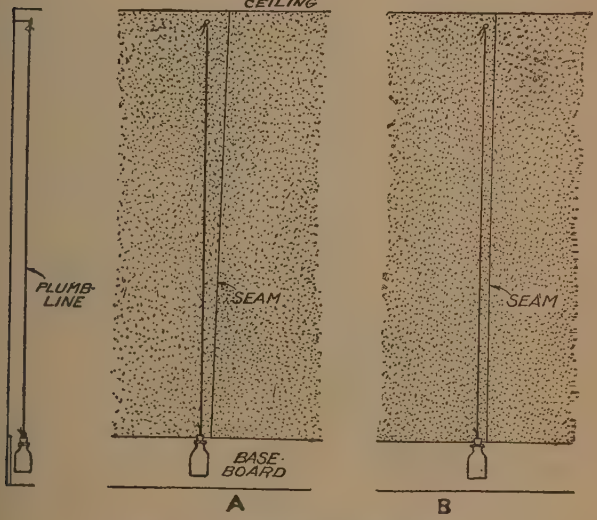


Fig. 138. Plumbing the Wall Strips.

tack or nail. The line will indicate the true perpendicular for the paper to follow. *A* shows an untrue seam, while *B* shows a correct seam. Some door casings and window casings are very much out of true; hence the advisability of relying upon a plumb-bob rather than the outline of the casing. Run the paper straight, even if there is a gaping gore of plaster left.

It is far better to fill up such a spot by patching in a piece of surplus paper than to have all the wall strips run at a noticeable slant, as they would do if you started your first strip wrongly, as at *A*.

Use your knife to trim off the bottom ends of the wall strips, as in *Fig. 139*, then paste down the edges very neatly along the baseboard.

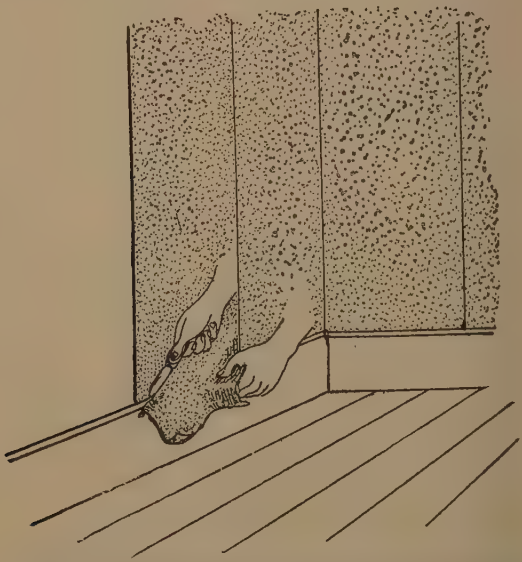


Fig. 139. Trimming Wallpaper at the Baseboard Line.

To Paper Around Wall Fixtures, considerable ingenuity is often called into play in order to do a neat job. The most common method of papering around an electric or gas wall lamp is illustrated in *Fig. 140*. Paste the strip down in the ordinary way

until you reach the fixture. Loosen the setscrew of the cap, *S*, and set it outward from the wall. Press the paper up against the opening in the wall and mark the position and size of the pipe, *R*, at that point. Make a horizontal slit in the strip, from edge to this point, as at *A*. Cut out the hole for the pipe. Spread the

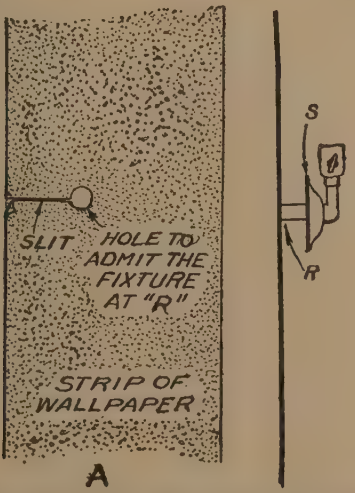


Fig. 140. Fitting the Paper Around Wall Fixtures.

slit of the paper wide apart and force the paper over the fixture and the hole around the pipe. Paste the paper to the wall, and the slit will not show. Return the cap of the fixture to its former position against the wall, which will cause it to cover any slight miscutting you may have done in making the hole in the paper.

Hanging the Border is done after all the walls are finished. Strike a chalk-line as a guide, generally

½ inch below the ceiling, and cut the border so the strip will reach from corner to corner; in other words, along one entire side. Cover the chalk-line when pasting the paper in position, and work from left to right, beginning in the darkest corner.

If the ceiling angle should be untrue, hang the paper so that the angle will appear true to an observer. A good way is to let each strip drop down a trifle, causing a slight but imperceptible mismatch.

Be careful to match patterns in the corners. You may have to waste a little of a border in order to do this, but it is well worth while.

Borders come in various widths, but when they are as wide as the wallpaper they are called friezes.

To mitre a border, fold the paper on a diagonal at the proper spot, open it again, then apply the paste. The crease will show where to do the trimming.

And for final suggestions:

Keep a cloth on the table, also one on your person, with which to wipe off pasty fingers or accidental spots gotten upon the paper.

After a strip of wallpaper has been coated with paste, give it time enough to become nearly wet through before hanging it.

Heavy papers require heavier paste than light papers. Never use sour paste, nor old paste. Neither will hold well. And do not have lumps in your paste.

Never let your paste brush lie on the strip of paper while it is on the table; the brush will be likely to stain the paper.

Don't use starch paste; it will crack certain kinds of paper and is not as cheap as a good flour paste.

Be careful to prepare enough paste for the whole job, and apply it cold. If you find your supply running low, do not thin it with water to make it "go farther;" make up some new paste.

Two pounds of wheat flour will make two gallons of paste, ready for use. This amount ought to do for an ordinary room, ceiling and walls.

A little alum in the paste makes it firmer, causes it to spread better under the brush, keeps it from souring and the paper from moldering on damp walls. One ounce of alum to the pail of paste is plenty.

If the wall has been painted with oil paint, or varnished, the paper will not stick well unless you give the wall a tooth by going over it with coarse sandpaper. Even a better way is to add a tablespoonful of Venice turpentine to a pail of paste.

If the wall or ceiling is very rough, you had better line it—that is, apply plain lining paper—before hanging your good stock. All ingrain papers should be hung over such lining, regardless of the surface condition of the walls, as lime contact is injurious to them.

Some wall cracks may be covered with muslin, but so-called prepared patching plaster is a more convenient and more permanent remedy.

Ventilate the room immediately after papering it, if it is not the cold season. In cold weather, do not open doors or windows, but let artificial heat dry out the walls.

XVII

WATER SUPPLY REPAIRS

It is quite surprising how very few special tools are required for us to make our own emergency plumbing repairs about the premises. Then, too, these few tools are not at all expensive, and it will be money well invested to keep them on hand, ready for the first call that arises.

The tools of a special character are merely two medium-sized pipe wrenches. In addition, such common household tools as a hammer, pocket knife, and monkey wrench will occasionally be needed. Good steel pipe wrenches can be purchased for about $1.25 each, in size 14, which is the size best adapted to home repairs. (See *Fig. 141.*)

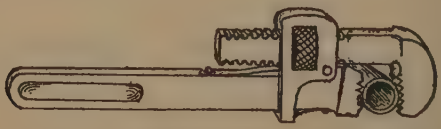


Fig. 141. An Excellent Type of Pipe Wrench.

The reason for possessing two pipe wrenches is that sometimes it is necessary to put together two loose sections of pipe, and in so doing some person must grip one section with one wrench while his assistant turns the other with the other wrench.

If your pipe wrench slips, it is usually a sign that you have put it on the pipe upside down. The teeth of the jaws are canted in opposite ways and it is neces-

sary to set the jaws on the pipe from the right direction, and then turn the wrench in the proper direction, in order to get the tool to grip properly. Sometimes the teeth break off on cheap wrenches, which makes them quite useless.

The Supplies you will need for home plumbing may also be quite limited, since it is possible, as a rule, for a person to buy fittings locally or by mail as the call for them arises. However, it is well to keep on hand a can of good pipe-cement (see *Fig. 142*), which can be secured at most hardware stores for about 30 cents; to have, also, a few gasket rubbers of a size to fit the various faucets in the house; likewise two or three lawn-hose splicers, and a couple of galvanized hose clamps. The latter cost only a few cents each.

Pipe Fittings, if required at any time, can be secured when the need arises. If your local plumber or hardware dealer cannot supply such, they can be purchased from one of the big out-of-town mail-order merchants by sending the concern the sizes you require. Parcel-post brings packages quickly nowadays.

The most used home pipe fittings are shown in *Fig. 142*. All fittings are known by the size of the pipe to which they fit. A ¾-inch pipe takes a ¾-inch fitting. The inside bore of the pipe will measure ¾ inch, while the inside bore of the fitting designed for it will really measure 1 inch.

Fittings should match the finish of the pipe, as a rule, upon which they are to go; that is, if the pipe is common steel, use a common steel fitting, or "black" fitting, as it is termed; if the pipe is galvanized steel, use a galvanized steel fitting. Galvan-

ized fittings cost slightly more than black fittings, but they have the advantage of resisting corrosion longer.

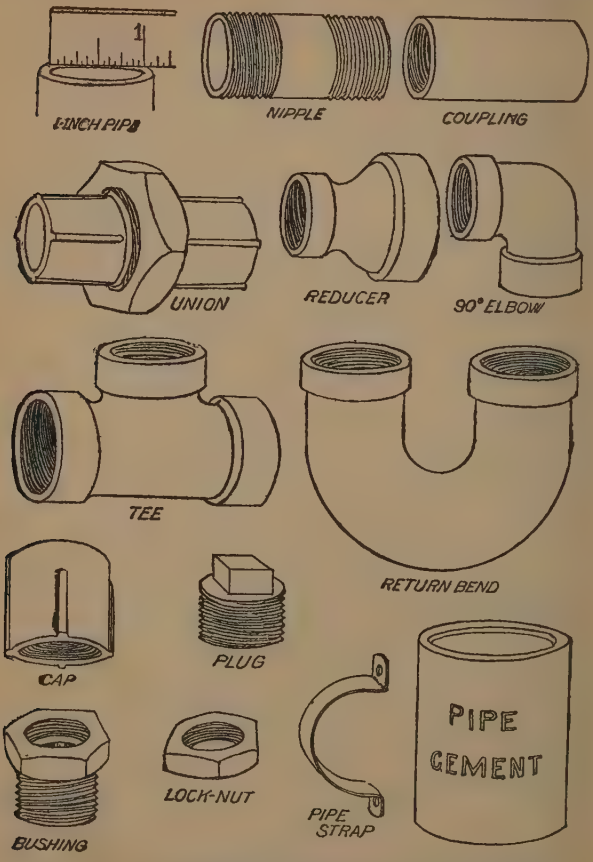


Fig. 142. Pipe Fittings Commonly Used in the Home

If you want to attach a smaller or larger pipe to

another, all you have to do is to insert between them a reducer coupling. The latter must be ordered, of course, so that each outlet will match the pipe end joining it.

Pipe also comes in a lasting galvanized finish. For use in steam and hot-water systems, black pipe is best. For supply pipes and waste pipes on plumbing systems, also drinking-water pipe lines, use galvanized pipe.

Pipe is in lengths of about 20 feet, threaded at both ends. The price varies according to the diameter and finish, ¼-inch black pipe selling for about 5 cents a foot, while 1-inch would cost 10 cents. Galvanized pipe averages about 2 cents per foot higher than black pipe, size for size.

Standard Sizes of Pipe, up to 2 inches, are as follows, all measurements being the inside diameters, the system mentioned previously:

⅛ inch
¼ inch
⅜ inch
½ inch
¾ inch
1 inch
1¼ inches
1½ inches
2 inches

To Secure a Short Section of Pipe, it will not pay you to cut it from a long section and attempt to thread the short piece yourself, as the cost of pipe dies is too great to make home-threading profitable. It is far better to go to your local plumber and ask him to cut off such a piece of pipe as you require and to thread it for you.

To Make a Tight Pipe Joint on New Work smear the threads on both pipe and fitting with pipe joint

cement, then screw the parts snugly together with the pipe wrench.

To Repair a Leaking Joint in Old Work, loosen the pipe and fitting enough to expose most of the threads. Apply pipe cement very liberally, and reset

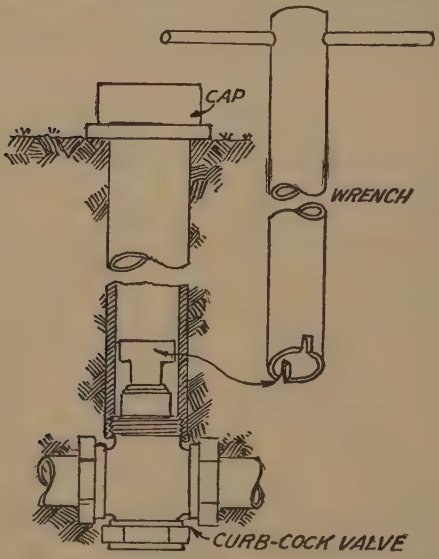


Fig. 143. In an Emergency Use This Wrench to Shut Off Your Water Supply in the Yard.

the parts. If this does not remedy the trouble, try putting in a new fitting, a new section of pipe, or both.

In Case of a Bad Leak, which cannot immediately be stopped, it is advisable to shut off the water supply from the street or main. Somewhere in your yard or by the roadside there is a curb-cock valve (see *Fig. 143*) which is reached by removing an iron cap

rising just above the ground. The removal of the cap discloses an iron pipe. Insert a cock wrench (which can be made out of small pipe) in this sheath until you can turn off the cock of the fitting just below.

Should you be unable to shut off the supply from

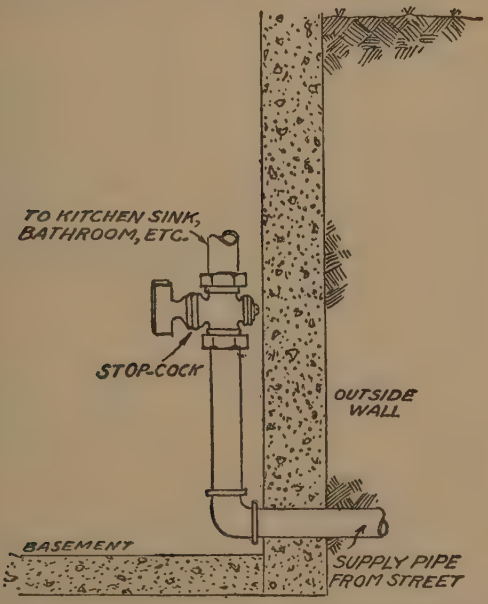


Fig. 144. In an Emergency, this Stop-cock in the Basement Will Shut Off your Water.

the street in this manner, you still have a good chance to stop the flow if you have a stop-cock in the basement of your house, as shown in *Fig. 144*. Such cocks are on the supply pipe reaching the house piping above, and a quick turn to the right will close them.

If You Leave Home for a Few Days or longer, be sure to turn off the water supply at either one of the heads mentioned. It is a great risk to your furnishings and home not to take this simple precaution, for it might be that a leak would develop in the inside piping during your absence and flood everything with water.

Frozen Water Pipes are a serious menace to the property as well as a great inconvenience to the owner and his family. In such an event, the pipe that is frozen is very likely to burst with the expansion of the ice within it, which will necessitate a new section of pipe before water can again be sent through.

Rather than invite such troubles as these, it is far better, if you live in a cold latitude, to take preventive measures. All piping exposed to the weather or in unheated portions of a house, should be heavily wrapped with old cloths, bound with newspaper, and the newspaper wound with strips of burlap. It is also a good plan, on extremely cold winter nights, to leave your faucets half open, so that the water can run into the waste pipe. Running water will not freeze. If the constant drip and splash disturbs your sleep, attach a short length of lawn hose to the faucet.

When your pipes do actually freeze up, inspect them for a possible split. If you find one, rest assured that that is at least one of the spots where freezing has taken place. Before thawing it out, either turn off the intake cock in the yard or the basement, or else bind the split with close windings of electrician's tape, as a temporary repair. Later, put in a new piece of pipe.

To thaw out a frozen pipe nothing is quite so good as a gasoline blowtorch, costing about $3.00; but in using this device be careful to see that the flame does not scorch your woodwork or set fire to anything. I have often seen women thaw out pipes with as simple a makeshift as a hot flatiron. This, of course, was set

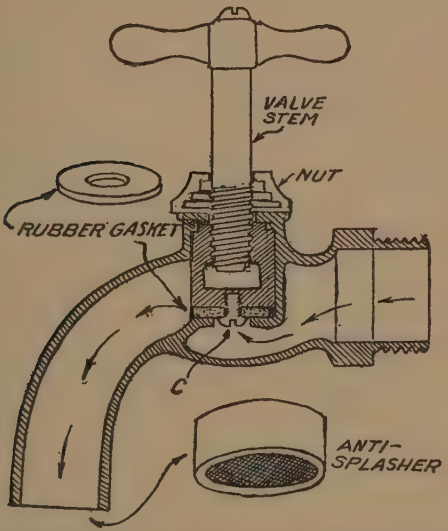


Fig. 145. Repairs for a Common Compression Faucet.

directly upon the pipe, resting for a few moments in each spot, until the ice within began to melt—an action which loosened it sufficiently to allow the crowding water behind to impel it forward to the first waste pipe.

To Repair a Common Compression Faucet (see *Fig. 145*), when the faucet drips and cannot be entirely closed off, it is only necessary to replace the old

gasket with a new one. Hot-water bibbs or faucets are especially prone to get out of order in this way, as the heat in the water tends to dry out the rubber with more than ordinary promptness.

As will be noticed in the diagram, all that you have to do in order to get at the old gasket (rubber washer) is to shut off the water in the supply pipe, unscrew the nut of the faucet, then unscrew the valve stem. On the lower end of the valve stem, attached by a small screw, is the gasket. Remove this, and replace it with a new one, which can be purchased at a plumber's shop or can be cut out of a sheet of gasket rubber with a sharp knife.

To Prevent Faucets from Splashing into a sink, which is sometimes quite annoying as well as destructive to adjacent woodwork and walls, either attach a short length of garden hose to the faucet, bringing the lower end of the hose down pretty well to the bottom of the sink, or slip a ferrule of tin or copper over the nose of the faucet, such ferrule provided, as in *Fig. 145*, with a wire screen. The latter contrivance can be made at home by any one handy with a soldering copper, or it can be bought at hardware stores for about 10 cents.

Sometimes disagreeable noises emanate from a partly open compression faucet which will not bother in any other way. As a rule, this trouble is caused either by a nut not properly screwed down or by a worn valve stem or a bad valve stem disc. First try tightening the nut; if that fails, purchase a new stem and disc.

To Repair a Sill Cock (see *Fig. 146*), which is located outside the house, and to which a hose is gen-

erally attached, proceed in much the same manner as with the common compression faucet. If the sill cock leaks, first shut off the water at the curb cock, to prevent a geyser when you remove the valve stem of the faucet. You can then easily replace a worn gasket

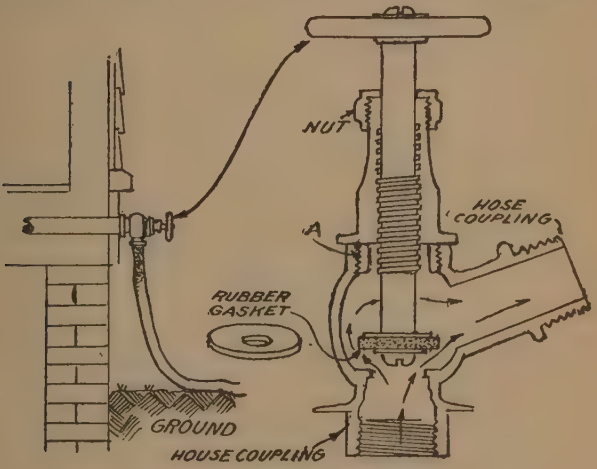


Fig. 146. Repairs for a Sill Cock.

with a new one, or make required repairs of other defective parts.

To Repair a Fuller Faucet (see *Fig. 147*), first shut off the supply cock to the house, then remove the nut confining the stem, as with other types of faucets. Next, unscrew the faucet from the pipe. This will allow ready access, with screwdriver and fingers, so that the old rubber ball, if worn, can be replaced.

Stopping a Leak in a Lead Pipe can be done either by soldering it or by filling it with red-lead putty

and wrapping it with electrician's friction tape. If the split in the pipe is long, whittle out a tapering plug of soft wood, coat this liberally with the putty, or with pipe cement, drive it gently into the aperture, then wind on the tape. Chapter X will supply information on soldering.

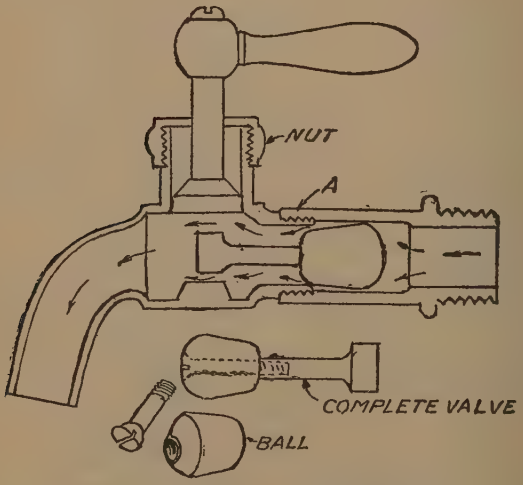


Fig. 147. Repairs for a Fuller Faucet.

Removing Obstructions from Pipes is one of the big items in the plumber's bill of repairs. He finds more of such work to do than almost any other class, because many home-owners simply will not be careful about what they throw into the waste pipes.

When trouble of this kind does occur, you will find that you can usually remedy the situation if you will only have the courage to go after it.

If, for instance, the water backs up in the bowl or sink, refusing to flow out with its customary freedom, first shut off the supply, then remove the nut of the trap cover, just below the bowl (*Figs. 148* and *149*). This will allow you to remove the cover itself and withdraw any refuse which may have lodged there.

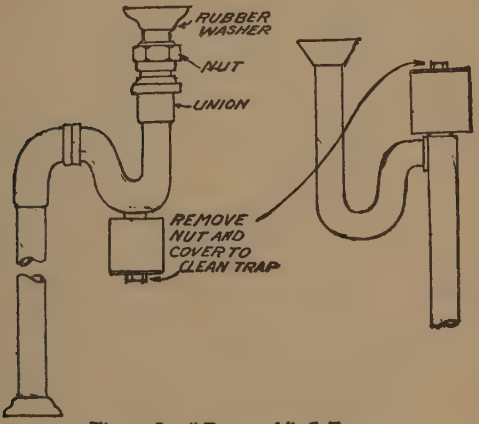


Fig. 148. "Dropped" S-Trap.
Fig. 149. "Elevated" S-Trap.

Replace the parts, turn on the water, and try the bowl again. If the pipe still seems clogged, run the bowl half-full of water, set into it a "plumber's friend," which is a large rubber suction cup attached to a pole, and, keeping the base of the cup hard against the bottom of the bowl, churn the pole up and down, as in *Fig. 150*.

Should repeated efforts of this kind fail, try running down into the pipe a hooked wire or a small

chain to the end of which is attached several small fishhooks.

To Keep a Flushing Tank in Order, you should know the fundamentals of its action. The bowl seldom gives any trouble aside from clogging, a remedy for

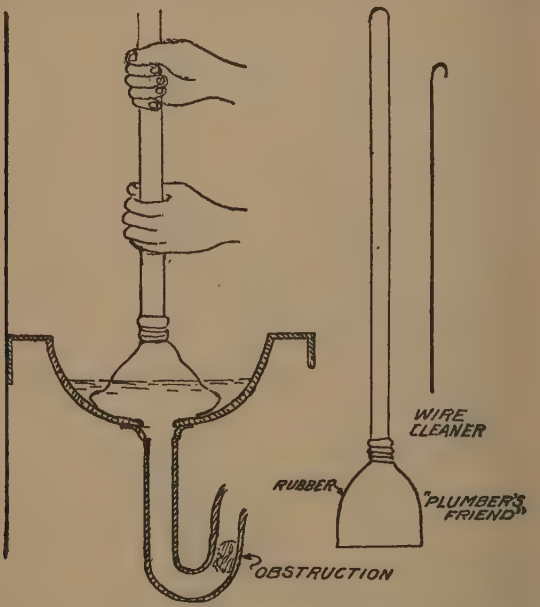


Fig. 150. Using a "Plumber's Friend" to Remove an Obstruction from a Bowl.

which has been given, but the tank is likely to "kick up" in different ways.

The mechanism of a common type of flushing tank is shown in *Fig. 151*. When the tank is full of water, the hollow copper ball floats, and its rod thereby auto-

matically closes the intake valve so that no more water can enter. As soon as the trip is operated by somebody, the flushing valve, *E*, or outlet, is opened. The float falls with the water level, and this action opens the valve of the supply or intake pipe, and the tank begins to refill. To prevent the tank from running over, the outlet is connected with an overflow pipe, *F*.

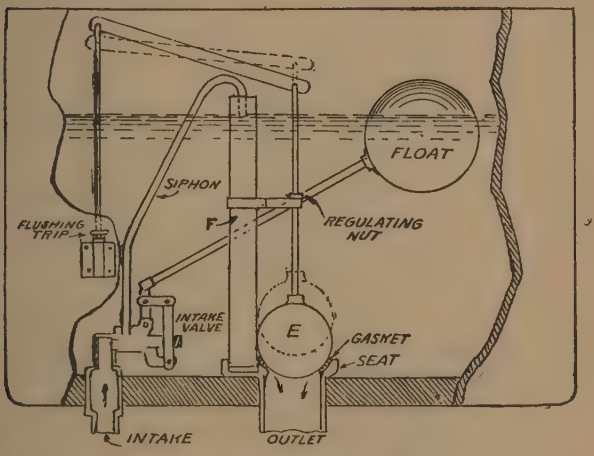


Fig. 151. Details of a Low-down Flush-tank.

One of the troubles that may develop is a faulty intake valve, which can be told by the fact that it lets some water flow all the time into the tank. This not only wastes the water, but it makes a trying noise—the sound of water seeping in the intake valve, as well as seeping out through the overflow pipe. To remedy it, shut off the supply of water, flush the tank, and carefully inspect the intake valve. If it has a poor

gasket, put in a new one; if certain parts are worn, remove them in favor of new parts; if pivot bearings are stiff, scrape them and lubricate with oil.

Another trouble is that of a poor-seating outlet ball, *E*, which will let more or less water in the tank con-

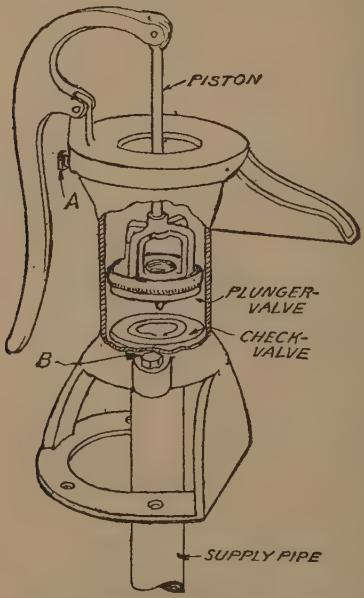


Fig. 152. Perspective Sectional View of the Valves of a Kitchen Pump.

stantly escape through the outlet pipe. This ball is generally made of rubber; it may become cracked; or it may get out of shape through long usage, and need replacement at the cost of possibly 50 cents. Or, if the ball is all right, the rod to which it is attached

may be bent so as to make it impossible for it to seat itself squarely upon the gasket at the mouth of the outlet pipe. Or the bracket sustaining the ball rod may have become knocked out of alignment and require a resetting. Or the gasket of the outlet pipe may be ragged and a new one may be needed. Such defects are not difficult to remedy.

To Renew the Leather Valves in a Kitchen Pump—and they undoubtedly do need renewing if your pump refuses to draw water at all, else needs a lot of priming to do its work—loosen the screw (*A, Fig. 152*) at the back of the pump. This will allow you to remove the handle, cap, piston, and plunger valve. You can then lay this upper section of the pump down upon a table or bench and easily get at the plunger-valve for removing the old leathers and replacing them with new ones.

There are two of these leathers, as shown in *Fig. 153*. One is a comparatively narrow ring; the other, or sleeve leather, is a ring of greater width. The mushroom valve rests upon the ring leather, and the sleeve leather sets under the rim of the plunger-valve and comes up around its outside. New leathers can be cut from a piece of common sole leather about 3/16 inch thick, first soaking the piece in warm water to soften it, or they can be bought ready-cut at most hardware stores. The size and form of cutting can be seen by examining the old leathers.

To get at the check valve leather, remove the bolts, *B*, at the waist of the pump casing, whereupon the upper portion of the casing may be lifted off, fully exposing the leather named.

Garden Hose often needs attention in order to get the longest use out of it. The hot sun is hard on any kind of rubber, checking and cracking it; therefore, it is a good plan to drain the hose thoroughly and then hang it where the sun cannot beat down upon it.

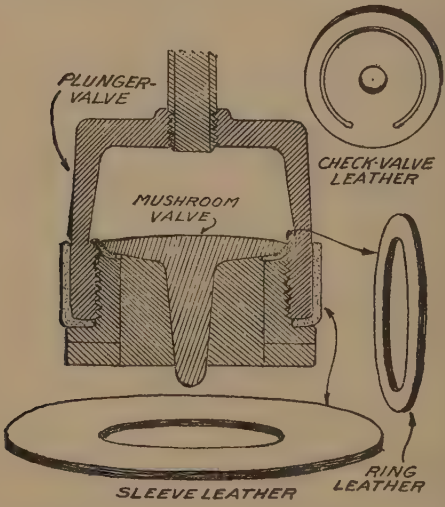


Fig. 153. Details for Replacing the Pump Valves.

When a Garden or Lawn Hose Bursts in any place, there are two ways to repair it. The temporary method is to bind the break with electrician's friction tape (see *Fig. 154*), which may really last a long time. The permanent method is to cut out the split portion with a sharp knife, and insert a metal splicer in each of the good sections, thus bringing the two long portions of the hose practically together again. To insure

the hose against creeping off, wind wire around it over the splicer corrugations, else bind it down by hose

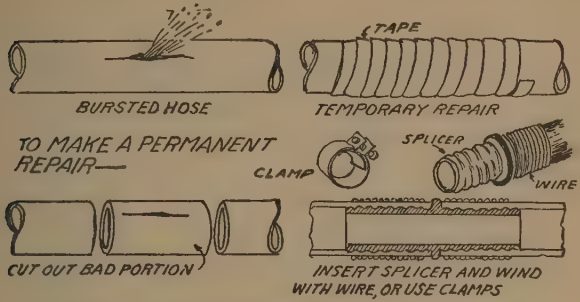


Fig. 154. How to Repair a Burst Garden Hose.

clamps. Such splicers and clamps can be bought at your local hardware store, or of any mail-order house, for about 10 cents each.

XVIII

HEATING REPAIRS

You can take care of the simple heating repairs about the home without outlaying any money in special tools or equipment. Such common household tools as a pair of pliers, a hammer, a monkey wrench, and a screwdriver, will do a good many services in fixing up contrary stoves and pipe.

Repair Parts for Stoves and other heating elements that cannot be made by the workman, can be purchased through a local hardware store, or secured by sending off to some of the big mail-order houses. Before ordering a repair part, be careful to note whether or not the defective part is stamped with a manufacturer's identifying name or number, and order by such a mark, giving sizes as well. If it is a stove that needs a new part, you can get it by writing to the manufacturer, whose name is usually stamped somewhere on the stove.

Relieving a Clogged Grate is sometimes required, because a huge clinker may have lodged between the plates in such a way as to prevent them from being turned over when it comes time to reverse them and let down all unburnable fuel. Do not try to dislodge the clinker, if it proves troublesome, until you have first emptied the fire-pot of its fuel. You can then work unhampered, poking with the stove poker at the clinker, and occasionally turning the grates as far as possible. If this fails to break up the clinker or to

A HOME-MADE SHELF ATTACHED TO A GAS STOVE

loosen it so that it falls out, take the grates out of their bearings.

If a Stovepipe Damper Burns Out, it will need a new disc in order to function properly. Pull the pipe apart where it joins the stove, and then withdraw the damper section of pipe from the rest. Reach into the pipe with a screwdriver and slightly bend open the straps of the disc which bind it to the rod. You can

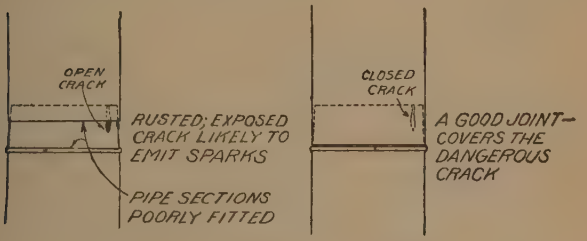

OPEN CRACK
RUSTED; EXPOSED CRACK LIKELY TO EMIT SPARKS
PIPE SECTIONS POORLY FITTED
CLOSED CRACK
A GOOD JOINT— COVERS THE DANGEROUS CRACK

Fig. 155. Making the Stovepipe Safe.

then pull out the rod, which will allow the damaged disc to drop free.

An expenditure of 25 cents will buy a new damper. Take the rod out of this, insert the disc in the pipe and push the rod through the pipe bearings and disc straps, afterward compressing the latter with a pair of pliers.

Fixing a Cracked Stovepipe (*Fig. 155*), is sometimes necessary. If the crack occurs midway of the pipe's length, you had better put in a new section of pipe, at a cost of possibly 40 cents. If the crack is at the end of the pipe, and it is not too long to be covered by the lapping ends when fully down, crowd the ends into such a covering position and this will

make a simple and safe remedy, for then sparks can no longer get through the aperture.

To Take Down Stovepipe for any reason, wear some old gloves on the hands, and be sure to lay out newspapers to catch the falling soot. It is much easier for two persons to take down pipe than one, also to set it up.

To Keep Stovepipe Joints Tight, see to it that any long horizontal reaches of piping are adequately supported. This can be done by passing broom wire once around the pipe, then running the ends off to screweyes or screwhooks set in the wall or ceiling on opposite sides.

To Keep Stoves and Stovepipe in Good Condition, give them a thorough treatment, if they are rusty or greasy, with some good prepared stove-cleaning compound. This can be bought for a small sum at almost any hardware store. Thereafter keep the stove well coated with regular stove polish, and the pipe coated with a high grade stove enamel.

To Fix a Crack in a Stove, apply a filling of prepared stove putty or iron repair cement. This will harden like iron itself and last quite a while. If continued heat causes the putty to crumble in time, it is an easy matter to fill the opening again with more of it.

To Move a Heavy Stove, let the fire out, remove the pipe, ashes, and all removable heavy parts; then tip up one end and let it down upon the brush of an old broom. With one person pushing from behind, and another person pulling upon the broom handle, the stove can then be easily slid over a smooth floor without defacing it to any great extent, if at all.

If, however, you have a coal-burner which you move annually from one room to another, the best plan is to make four caster blocks (*Fig. 156*) to put under the

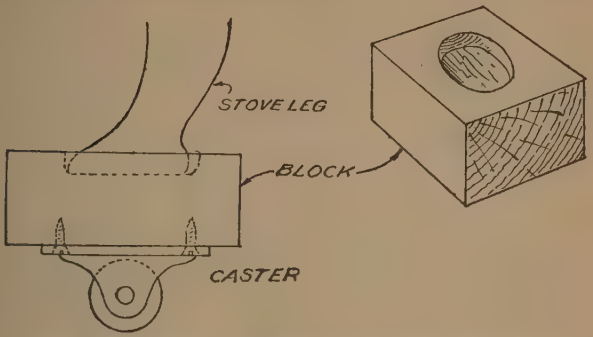


Fig. 156. Four Blocks and Casters Are a Great Aid in Moving a Heavy Stove.

legs when the time comes to shift it. These blocks can be recessed on one side to receive the stove leg, while the caster is screwed to the opposite or under side. Suitable casters for this can be purchased for 10 cents each.

To Clean the Isinglass in your coal stove, open the doors and remove them by lifting out the hinge bolts. It is then an easy matter to wash off all ash dust with a damp cloth and to give the isinglass a polish on both sides with a cloth saturated with vinegar.

Should Isinglass be Broken, remove it by bending it out of the door clips. At your hardware store, sheets of new isinglass can be purchased for a few cents each. Trim these down to fit the panel, using a pair of scissors, then slip them into place by a slight bending. It never pays to leave holes in old isinglass,

for such openings give a fine chance for dangerous coal gas to escape and overcome you as you sleep.

If the Draft Is Poor in your fireplace, furnace, or stove, and you can find nothing the matter with the piping or the dampers, go outside and take a look at the chimney. If your chimney is lower than the ridge of the house (*A, Fig. 157*), or little higher, it cannot

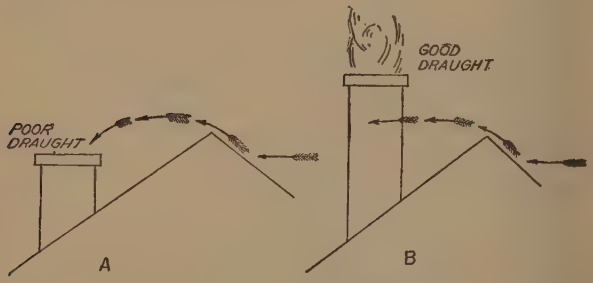


Fig. 157. Poor and Good Draughts.

draw well, and you should get a mason to extend it for you so as to produce the effect shown at *B*.

To Get More Heat from a Hot-air Furnace, if the piping is not insulated, cover the piping with sheet asbestos. This material can be bought very reasonably at most hardware stores, and is very easy to apply. All you have to do is to wind it closely about the pipe, lapping one end over the other as you proceed; then bind the joints together with the metal straps supplied for the purpose. (See *Fig. 158.*)

Gas Escaping from any pipe will burn, but it will burn with a yellow flame. To make gas burn with a blue flame—that is, to secure a complete combustion—air must be mixed with it. This is done through a

device on a gas stove called the air mixer. The air mixer is equipped with adjustable shutters by means of which the owner can admit as much air to the burners as they require for proper burning.

As a rule, when gas stoves are purchased they are correctly adjusted in all particulars, but sometimes a jar, or series of jars, will disturb the air mixer shutter

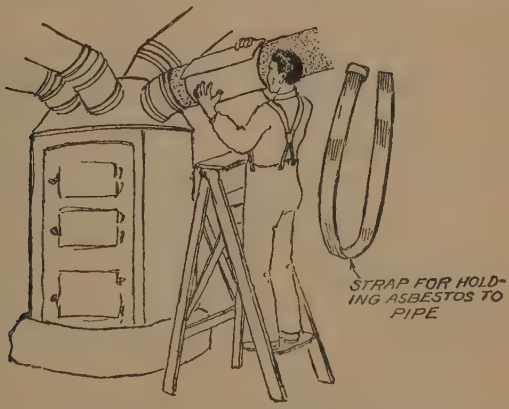


Fig. 158. Applying Asbestos Sheeting to Retain Heat in the Piping of a Hot-air Furnace.

adjustment so that the burner works very badly. Such jars are usually occasioned by the owner's lack of knowledge of lighting a gas burner. He applies the match the instant he turns on the gas, which causes the gas to ignite in the air mixer with a loud pop, instead of igniting at the burner, as it should. These explosions soon jar the shutter of the air mixer out of adjustment, and it will need fixing; whereas, had the owner turned on the gas and waited long enough

to count three before applying his match he would not have had any trouble.

To Repair a Gas Burner with a Defective Air-Mixer (*Fig. 159*), remove the grate of the gas stove and lift out the burner. First, brush and wipe off the burner, to clean it of all grease and dirt; then loosen

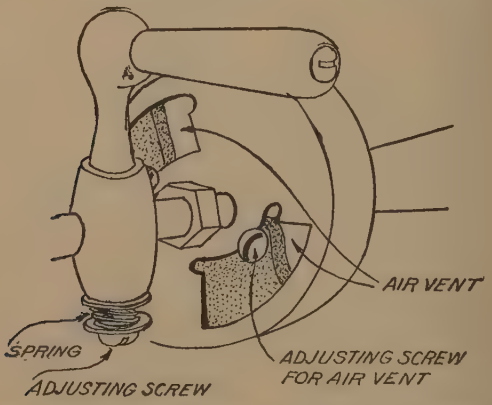


Fig. 159. Adjustments for Regulating the Valve Tension and Air Mixer of a Gas-stove Burner.

the shutter adjusting screw of the air vent and either close or open the vent a trifle, resetting the screw.

Replace the burner and grate, and ignite the gas. If it fails to burn properly, again remove the burner and change the air vent until you get it right, which will not take long.

To Clean a Gas-burner, scrub it with a stiff brush and wash all greasy parts with soap and water. If the holes in the burner are clogged, use a wire or hairpin to poke out the foreign matter.

If You Smell Gas in the room it is a pretty sure indication of a leak somewhere in the supply line or the taps. When such an odor is noticed strongly, open windows and extinguish all open fires. Whatever you do, do not strike a match and look for the leak; nor should you use a lamp or other open flame in the process of search, for an explosion is likely to take place. Do your hunting after dark with an electric lamp.

Look first at the valves on your gas stove. One of them may be open. Then examine any other gas jet valves which you may have in the room or the house. If the odor of gas is not especially strong, and you have the doors and windows open, strike a match and hold it close to the valves. Do the same at suspected pipe joints. If there is a leak, the flaming match will ignite the escaping gas and a tiny blue flame will indicate the location of the leak.

The next thing is to repair the leak.

If a Pipe Joint Shows a Leak, shut off the gas supply to that portion of the system, and take the joint apart with a pipe wrench. Apply pipe joint cement to the threaded portions of the pipe and then reset the sections.

If a Pipe Leaks at a Split (*Fig. 160*) apply pipe joint cement or stove putty to the opening, crowding it in well, then wind it with several layers of electrician's friction tape, binding down the tape with fine wire spirally applied. Such a remedy will prove efficient for quite a long while with small splits, but if it is a large one, the section of pipe containing the break should be removed and a new piece inserted.

To Fix a Loose Gas Burner Valve Stem—one which turns so easily that it is likely to open by a garment lightly striking it—find the adjusting screw underneath the stem and give this the proper number of turns with a screwdriver. If the screw has been tightened before, until it will no longer operate effectively, it is a sign that the valve itself is worn out and that it must be replaced with a new one. You can purchase one from the dealer of whom you bought the stove.

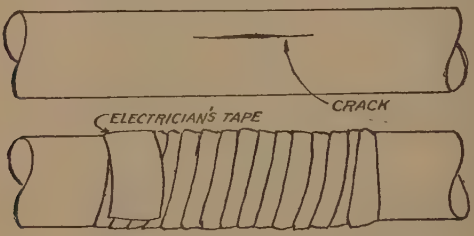


Fig. 160. Repairing a Split Gas Pipe.

Shut off the gas supply to the stove before making any changes, then unscrew the old valve and put in the new one.

When a Gas Stove Gets Shabby, it should be thoroughly scraped, to free it of old scaly paint, washed with soap and water, and then given two coats of enamel of a color to suit you. Black, white, and blue all look well. For applying such a covering, see Chapter XV.

To Add a Shelf Under a Gas Stove (see *photograph,* 264), first make a bottom by fastening boards together so that they will fit between both legs at one end of the stove. Cover the top and edges of the

bottom with galvanized sheet-iron, procurable at most hardware stores for about 50 cents, fastening with tacks driven through small holes punched in the metal.

Attach the legs end of the shelf by drilling holes through the legs and galvanized iron and driving in wood screws. Attach the opposite end of the shelf by straps of galvanized iron screwed to the shelf and fastened above by stove-bolts passing through the railing of the stove.

Give the shelf two coats of appropriate enamel, directions for applying which will be found in Chapter XV.

To Light a Kerosene Stove, turn the valve which permits the oil to flow into the cup below the burner. Wait a moment for the wick to become saturated with oil. Raise the chimney and touch the lighted match to the wick at several places. Lower the chimney, and adjust the wick to the proper height to get a blue flame; do not turn very high at first, for the flame will creep upward somewhat as the burner becomes heated. After a minute has passed, it will be safe to turn up the wick to the maximum height you desire, being careful not to get it so high, however, that it smokes.

To Extinguish a Kerosene Stove, turn each wick clear down; otherwise, although its flame may smother out, there may be enough of the wick left above the burner to distribute oil to surrounding metal parts while standing idle, which will cause disagreeable smoke and odor when the wick is again lighted.

To Maintain an Even Flame in a Kerosene Stove, set the stove perfectly level. Keep the charred edges of the wick trimmed with scissors.

If a Kerosene Burner Blazes Beyond Control of the valves or levers, remove the tank and carry it to some safe place where the kerosene in it cannot catch fire. Let the burner burn itself out, as it soon will do, while you open doors and windows to let out the gases and smoke. Then remove the chimney, brush out any soot that you find inside, and try to locate the trouble. Blazing may come from wicks of a wrong size, or from wicks getting so short that the screw on the lever fails to move them up and down. Or the ring in wickless stoves may not be thick enough, or it may have slipped out of place, or become broken. The remedy is to replace the old wick or ring with a new one of the correct size, and your dealer can supply this.

If the Wick Controlling Lever of a Kerosene Stove Has Become Broken or otherwise ineffective, you can put in a new one, secured from the stove agent, or if this is too difficult, a new burner should be installed.

To Keep a Fireless Cooker in Good Condition, leave it in the open air when it is not in use. As soon as the food and stones are removed from it, wipe out the moisture and wash the inside with soap and water, wiping dry. Such care is needed in order to make the cooker sanitary and to prevent the device from taking on the odor of food previously cooked and transmitting such odor to foods cooked later.

To Repair a Leaking Radiator Valve (*Fig. 161*), remove the nut, *B,* and note if the gasket within the nut is in good condition. If it is not, replace it with a new rubber, else use a piece of greased candle-wicking.

The trouble may also lie in the lower gasket, *C*. This can be reached by unscrewing the barrel, *A*, and removing it and the valve stem. If the lower gasket

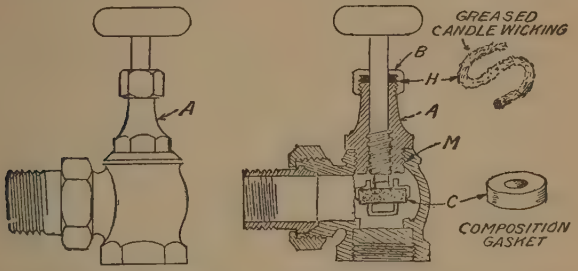


Fig. 161. How to Repair a Leaking Radiator Valve in a Home Heating Plant.

is worn, you can either purchase a new one or make one out of a piece of gasket rubber.

XIX

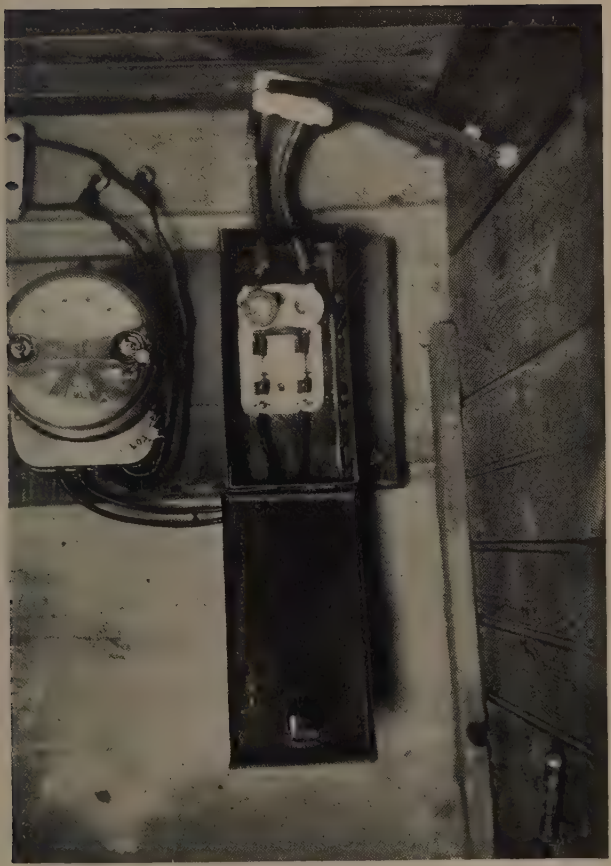
ELECTRICAL REPAIRS

Most homes are equipped with electricity nowadays. And this versatile, energetic fluid is harnessed not only to give illumination at night and on dark days, but likewise is induced by the ingenuity of man to help sweep the rugs, to dislodge dust, to wash and iron clothes, to curl milady's hair—and little Betty's, too,—to heat with, to cool with, to sew with, to reproduce phonographic music with, to receive radio entertainments with, to ring door-bells and annunciators, to operate burglar alarms, to start and light the automobile, and numerous other astounding uses.

Under such universal application as this, it is obvious that the householder who knows the fundamentals of electrical science, as identified with the home, will find a-plenty to do in the way of repairs and upkeep; will have a more efficient home, and will save considerable money that would otherwise go into the pockets of professional electricians.

The Tools Required for making electrical repairs (*Fig. 162*) are very simple and inexpensive. Most homes are supplied with at least half of them. You will need a pocket-knife, a hammer, a medium-sized screwdriver, a small-sized screwdriver, a pair of side-cutting pliers; a soldering copper, and possibly a brace and a $\frac{5}{8}$-inch auger bit.

The Supplies Required (*Fig. 162*), will be a roll of electrician's friction tape, three bulbs of the kind you use mostly, three fuses of the amperage necessary,



FUSE BOX, SWITCH AND METER COMMONLY FOUND IN HOMES WIRED FOR ELECTRICITY

and some solder and flux. You might also have on hand 25 or 30 feet of insulated 14-gauge wire and 15 feet of double lamp-wire, for emergency calls; but other supplies can be bought as actually needed.

The two forms of conduit shown in *Fig. 162* are used to encase wires and protect them from dampness and chance abrasion. Most cities now have laws compelling the use of such conduit, in order to reduce the fire hazard.

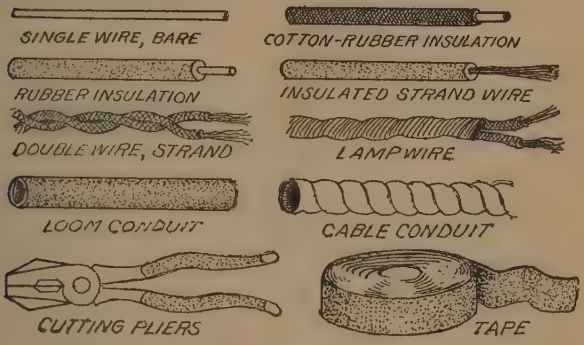


Fig. 162. Materials and Tools Used in House-wiring.

Local Laws on Home Wiring should be looked up before you attempt to put any new wiring in your house, for different cities have different requirements and many municipalities make it a misdemeanor to install wiring otherwise than specified without a city permit. You can, however, make ordinary electrical repairs without a permit.

Before attempting to do a real job of wire splicing or terminal connecting, it is a good plan to practice such joints with short pieces of wire.

To "Skin" Solid Wire (*Fig. 163*), which means to remove a part of the insulation in order to make a connection of some kind, shave off the insulation on opposites sides, with a sharp knife, as at *A*. Then shave off the remaining rubber, as at *B*, until the wire is fully exposed. Next, scrape the wire with the knife—the back of the knife will often do for this—until it is bright and clean.

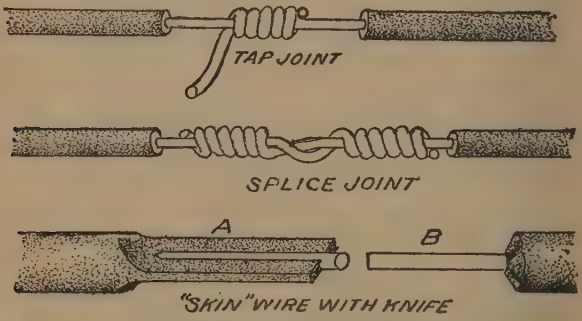


Fig. 163. How to Make a Tap and Splice Joint.

To "Skin" Strand Wire (*Fig. 164*), shave off the insulation in the same manner as with solid wire, but be more careful about it, as the fine wires of the strand cut through very easily. Scrape the wires until they are clean.

To Loop Strand Wire for a Terminal Connection, such as when connecting it to the screw of a socket, twist the brightened wires between the thumb and forefinger until they are in a stiff, straight form, as in *Fig. 164*. They should then extend about 1 inch outward from the insulation. Form the end into a loop, as shown.

To Make a Terminal Connection with Strand Wire, loosen the nut upon the terminal screw of the socket or other device to which the wire is to be connected. Loop the wire closely around the projecting stud, so that the lapped end is on the under side and in such a position that, when the nut is tightly screwed down, the loop of the wire will close rather than open under the friction.

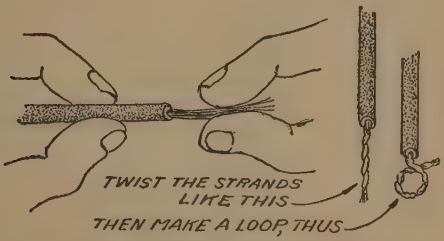


Fig. 164. How to Connect Strand Wire to a Screw Terminal Such as on an Electric Lamp Socket.

Remember, in making electrical connections with wire, that you will never get a good flow of electricity through the united parts if either one of them is greasy, dirty, or loose. Make certain that all touching parts are clean, also that they are firmly in contact, either by screw friction, by spring friction, or by soldered connection. A plain twisted joint may serve for a while, but it is sure to corrode in time and cause poor contact; and it may pull loose.

To Make Current Flow through a wire there must be electrical pressure behind it, just as there must be a pump to force water through horizontal or up-grade pipes in any watering system. The force of

the current, in either case, will depend entirely upon the amount of pressure exerted from its source of supply.

Electrical Pressure is called voltage and is measured in volts; hence a lamp marked 10 volts requires just twice as much electrical energy behind it to light it successfully as a lamp marked 5 volts. Most house circuits operate under a pressure of 110 volts; therefore, bulbs should be used which are made to operate

Fig. 165. A Common 1.5-volt Dry-cell.

at that voltage. If of less voltage, their filaments—the fine, thread-like wires inside the bulb—will burn in two, destroying the lamp; if of greater voltage, the filament will not receive sufficient current to heat it to a white glow and it will give off a very dull illumination.

When only a small quantity of current is required to operate a device, a dry-cell battery (*Fig. 165*) will suffice; such a battery comprising one or more cells, as required, just as more power can be exerted by several horses hitched together than by one horse. But

there is a limit to the number of dry-cells you can use economically. For this reason, it does not pay to try to operate ordinary house lamps by dry-cells, as they take too much current.

Where somewhat greater quantities of current are needed than dry-cells can produce profitably, a storage battery will fulfill the requirements. Yet this type of battery is an unprofitable one to use for more than half a dozen 5-volt lamps.

For still greater current, such as required in the lighting system of the modern home, the most efficient electrical pressure thus far discovered is that which is manufactured by dynamos owned by great corporations and which is sent through wires to ourselves and our neighbors alike.

Dry-cells are a paper-covered zinc can containing an outjutting stick of carbon and a quantity of paste-like chemicals which are sealed in at the top with tar or wax. One terminal is attached to the rim of the zinc can; the other terminal is connected to the carbon.

When a dry-cell is in use—that is, when the current is flowing through wires connected to it and thus making a circuit—the chemicals in it become active and "eat" the zinc of the can, while, at the same time, the can also "eats" the chemicals. This warfare gradually weakens the strength of the combatants—also your electrical pressure!—until finally extermination is so complete that you find your battery is quite useless. You might just as well throw it away then, for dry-cells cannot be successfully rejuvenated. Continuous use runs them down very fast.

Dry-cells are used extensively for ringing door-bells

and interior annunciator bells; for lighting Christmas-tree miniature lamps, radio tubes, flashlights, bicycle lamps, and for operating electric clocks, and other low-pressure articles.

As stated previously, electrical energy can be increased over that possessed by one cell if two or more are connected with it, two cells having double the power of one, and four having twice the power of two.

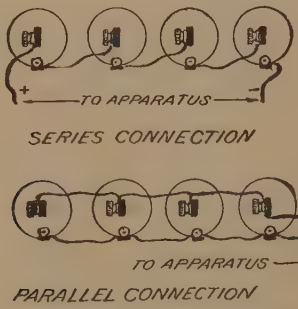


Fig. 166. Two Ways of Connecting Up Batteries.

There are two ways of connecting dry-cells for teamwork. These methods are as follows:

To Connect Dry-cells in Series (*Fig. 166*), connect one lead-wire (the lead-wires proceed from your instrument terminals) to the positive or carbon terminal of one end dry-cell, and connect the other lead-wire to the negative or zinc terminal of the other end dry-cell. Then, using short lengths of wire, connect the positive terminal of one cell with the negative terminal of its neighbor.

To Connect Dry-cells in Parallel (*Fig. 166*), fasten one lead-wire to the negative terminal of one

end cell, and attach the other lead-wire to the positive terminal of the same cell. Connect all the negative terminals of the cells with a single short length of wire, looping it snugly around each stud and screwing down the nut upon it. Then connect all the positive terminals in the same manner, using another short length of wire.

In the drawings referred to, the symbol + stands for the positive wire or terminal, and the — stands for the negative wire or terminal.

To Test a Dry-cell (*Fig. 167*),—that is, to de-

Fig. 167. The Spark Test for a Dry-cell.

termine if it is in good electrical condition,—connect the two terminals with a short piece of insulated wire whose ends have been bared. Tap the ends up and down upon the terminals, and, if the cell is good, sparks will be seen. If, on the other hand, the cell is "dead," no sparks will be emitted by a making and breaking of the circuit.

A Storage Battery, unlike a dry-cell, does not develop electrical energy. It is merely a storehouse for such electricity as you may put into it through tapping the house current or a similar high voltage. Its lead plates, immersed in dilute sulphuric acid, form

a chemical action when the circuit has been closed which allows the current to flow to the apparatus. A special device called a charger is required for re-energizing a storage battery when it is exhausted. You can buy such a charger for about $10, or have a service station recharge your battery for about $1.

Such batteries are used in practically every automobile, and most radio sets of the home also employ them. Explicit directions for their operation and maintenance are given on a card attached to each battery when purchased. Their average life is about two years, but if you have a service station renew your lead plates when they become deficient, your battery will last longer.

The Flow of Electricity is, in some respects, like the flow of water, as I have shown, inasmuch as there must be a force behind it to carry it on. But there is this difference: Water will flow out of the end of a pipe if pressure is applied; electricity will *not* flow out of the end of a wire, no matter how much force is back of it, unless that wire end is connected to other conductors which lead around, like a loop, to the opposite terminal of the same instrument (such as a battery) from which the current started. Such a continuous path for the flow of electrical current is called a circuit. A circuit must be complete—no break in it—or the current will not flow. Therefore, it is evident that two wires must be connected to every piece of electrical apparatus; that every circuit must lead from one side of a battery to one side of the bell, lamp, or whatever it may be, and from the other side of the apparatus back to the other post of the battery.

The Bell Circuit is one of the simplest, and the simplest manner of operatively connecting a bell to a dry-cell is to touch its terminals to the terminals of the cell itself. The current then flows directly through the bell and dry-cell and causes the bell to ring. Such an arrangement would be of very little practical value, however, and is never used, except as a test of battery or bell.

In houses and other places where bells are used as

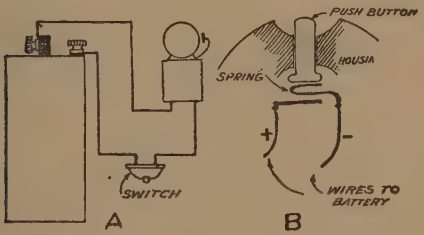


Fig. 168. A Bell Circuit, and Details of a Push-button Switch.

signals, the battery and the bells are some distance apart. This makes it evident that two wires of the proper kind must be run from the bell to the dry-cell. If this is done, however, the bell will ring continuously, which would not do at all, so you can see that some instrument must be placed in the circuit in such a way that you can "make" and "break" the circuit at will. This intermediate device might be, for instance, a button operating a spring which will leave a gap in the conductor line when the button is not touched, and which will bridge a short conductor across the gap, closing the circuit when the button is held down. Such a device is called a switch, and there are

many forms of them, all working upon the same general principle of make and break control. In *Fig. 168*, at *A*, is shown a bell circuit containing a push-button switch; at *B* of the same diagram, is shown the acting principle of the switch itself.

Bell Circuit Troubles arise mostly from weak or worn-out batteries, dirty terminals, loose connections

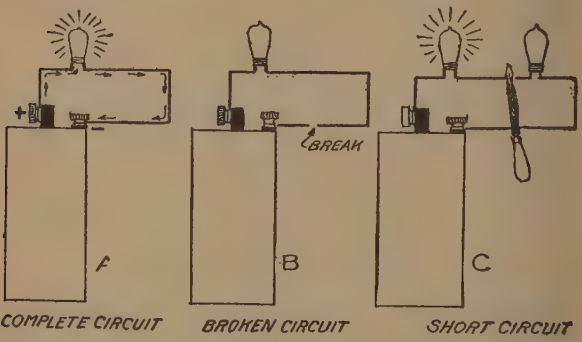


Fig. 169. There Must Be a Complete Metallic Circuit, without Short-cut Connections, as at *C*, to Operate Electrical Apparatus.

on the push-button, loose connections on the bell, a break in the circuit, or short-circuited wires.

A Short-circuit means there is a connection between the lead-wires before they get to the bell or other apparatus, such naughty connector permitting the current to flow from one terminal of the battery to the other without going to the bell at all. (See *C*, *Fig. 169.*)

When Repairing Bell Circuits, be sure to replace all weak or worn-out dry-cells. These can be tested by the wire method given previously, but if you are sure

your bell is good, a better test is to touch the bell terminals directly to the cell terminals. If a ring results, look for one of the other troubles enumerated in a preceding paragraph; it is neither your bell nor your battery. Take the push-button apart and note if the spring makes a good contact when the button is depressed, and if it breaks the circuit when the button is released; then clean all the contact points with emery-cloth or fine sandpaper.

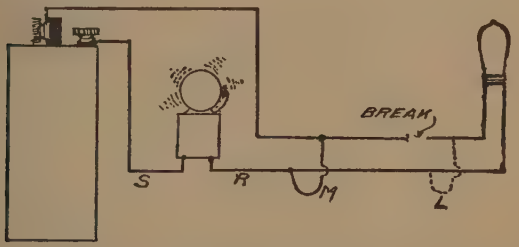


Fig. 170. Testing with a Bell and a Short Wire to Locate a Break in the Circuit.

If the bell does not ring, there must be a break in the circuit, else a "short."

To Test for a Break, close the push-button or short-circuit it; disconnect one of the wires from the battery, and connect a bell between it and the terminal from which it has been removed (*Fig. 170*). Then take a test-wire, *M*, and, at intervals, along the wires running to the bell, remove a little insulation on both wires and tap the test-wire across them. If the test-bell rings, the opening is nearer the main bell. This should be continued until the break is located and spliced.

To Test for a Short-circuit (*Fig. 171*), disconnect one of the wires from the battery, and connect it to one terminal of a good bell; then connect the other side of the bell to the battery. If the bell rings, there is a short-circuit. Another way to do this without the use of a bell, is to touch the wire disconnected from the battery, and the short one connected to it for testing, to the tongue, keeping them about ¼ of an inch

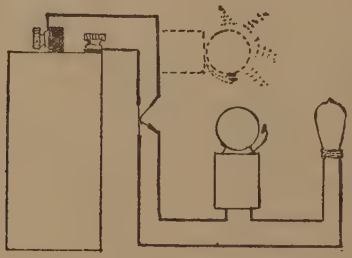


Fig. 171. Using a Bell to Test for a Short-circuit.

apart. If current flows, a sort of sour taste will be noticed. These tests should be tried with the push-button closed. If a short-circuit is detected, it may be found to be due to the cutting of the insulation by staples, especially if some poor electrician has put two wires under one staple. Remedy such a trouble by removing the staple and winding the exposed wire with friction tape.

Battery Lighting is at the present time of very great importance to the home-owner, because of its extensive use in automobiles and radio sets. In the automobile, a storage battery is the source of power, while the radio uses both dry-cells and storage battery.

Battery Lamps are designed for use with dry-cells and storage batteries. They are made to use with small receptacles or sockets, and are put into place, after the wiring for them has been completed, by turning them, or pushing them, into the sockets, as the case may be. A mark of 6v means that the lamp bearing it is intended for use on a 6-volt battery.

Operating a Lamp on Too High a Voltage will prove disastrous to it—as disastrous as connecting a toy balloon to an air-line designed for inflating automobile tires. In electricians' vernacular such a current will "blow out" or "burn out" the lamp, melting apart the delicate filament and thus breaking the circuit. It is obvious, then, that care should be taken in every case to note the voltage mark on the lamps about to be used and to make sure that the pressure supplied by the battery does not exceed this value.

Operating a Lamp on Too Low a Voltage will not injure it, but, as there is insufficient electrical power to heat the filament to the required white glow for good illumination, the result will be a dull red or yellow filament and the very weakest of light rays.

A Battery Lighting Circuit, in a general way, is the same as a bell circuit. The chief difference is that a lamp or lamps are substituted for the bell. There must be a controlling switch of some kind for both, although in the case of a lighting circuit employing several lamps, there may be as many different switches, each one handling its own particular lamp. Another difference is that automobiles usually use what is called the one-wire circuit. This statement might be misleading to the layman, but is easily explained. The

current does not flow to and from the lamps through the same wire, as you might interpret; it is led to the lamps by one wire, but is returned by means of the steel frame of the car, which is a fairly good form of conductor and acts in the capacity of the regulation return-wire of the common wiring system.

Parallel and Series Connecting of Lamps is done in the same manner as in wiring up batteries by these two systems, which has been previously described. When two or more lamps are connected in parallel, and one of them burns out or is removed, the other lamps will continue to burn without impairment. In a series connection, if anything happened to one lamp the others would not operate, because current cannot flow through the affected lamp and therefore has no way of continuing on through the others. The latter system is used in connecting the dash-lamp and tail-lamp on an automobile, so that if the tail-lamp becomes useless, the dash-lamp will go out also and notify the driver of the first trouble. All of the other lamps on a car are usually connected in parallel.

It should be remembered that when lamps are connected in series their combined voltage must not exceed the rated voltage of the battery used. You cannot, therefore, use four 3-volt lamps with a 6-volt battery; but you can use four 1.5-volt lamps with such a battery.

Heat from Electrical Currents is something very easily generated. In fact whenever electrical current flows through a conductor, heat is produced. It may be very small in some cases, where no steps have been taken to secure such an effect, but where an effort has

been made to generate heat you will find it in the maximum degree. For instance, grasp an electric bulb after it has been burning a few minutes and you will find it almost too hot to hold—an example of natural electrical heat. Touch your finger to the glowing coil of a toaster and you will be badly burned—an example of special generation over the same powered line.

How is this? The amount of heat generated when a current of electricity flows through a conductor depends upon the difficulty the current has in passing through the conductor and the rate at which the pressure behind it makes it flow. This being true, you will see that it is possible to force considerable current through a large wire having a low resistance without causing the development of much heat; while, on the other hand, it is possible to select a conductor having a very high resistance and thereby to cause the generation of a large amount of heat by forcing a comparatively small amount of electricity through it.

Common Heating Devices depend upon this principle of resistance for their operation. In other words, their special property is invested in a part called the *heating element,* which is so designed by the manufacturer as to have a very high resisting quality.

In *Fig. 172* is shown a simple circuit, without switch, which incorporates a heating element that is boiling the contents of a teakettle. This element might just as well be a toaster or any other form of heating resistance. Two heavy copper wires are connected to the current supply, or battery, and between their ends is bridged a piece of very fine wire in the form of a coil. This coil is the heating element; it is wound in

this form so as to get as much wire as possible in a small space; it is so much smaller in size than the main wires that it offers a comparatively high resistance—so high, in fact, that it becomes white hot, almost melting, and in that condition discharges a lot of heat.

To Repair Electric Heating Devices which refuse to generate the proper amount of heat, your first suspicion should be directed toward the heating ele-

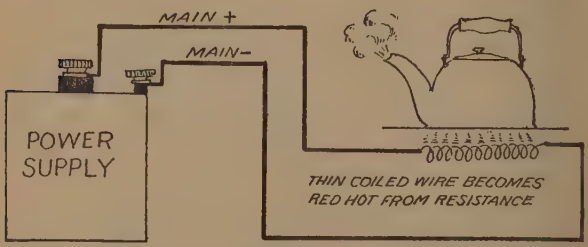


Fig. 172. How Electrical Heat is Generated for Home Cooking.

ment. The chances are ten to one that the coil has either become detached at one end or the other, or has burned in two from long use. A little inspection will soon show you how to remove the shell of the device and get at the coil. If it has slipped off at its end connections, hook it back on. If it has burned in two, you should order a new coil from the dealer of whom you purchased the device, and then remove the old coil and install the new. All heating coils will burn off in time, whether in a flat-iron, a toaster, a hair-iron, or an electric stove.

The Parts of an Electric Flat-iron are shown in *Fig. 173*. You will note how very easy it is to take

such an apparatus apart for repairs. Other heating elements are little more difficult to understand.

Fuses are safety devices placed in an electric circuit for the purpose of protection. Suppose, for example, an accidental connection is made in a circuit, causing a short-circuit. This would provide an easier path for the flowing current, which always prefers the shortest route back to the source of energy, but yet

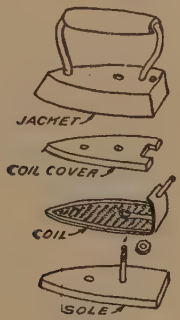


Fig. 173. Parts of an Electric Flat-iron.

enough of it would follow around the long way to cause collision in the two forces and thereby would set up such an abnormally high resistance that the insulation on the wires would be likely to burn off and set fire to the building. To safeguard against such accidents as this, fuses are inserted in the circuit.

Fuses (*Fig. 174*) have in them a piece of very soft metal which is known to be capable of carrying only a limited amount of current without melting. Thus, if a fuse marked "10 amps." is used in a circuit, only ten amperes of current can be drawn through the circuit without melting the fuse wire. The moment it

does melt, a break is formed at this point in the circuit, and electricity will no longer pass through it, nor will lamps light or any device operate within its belt.

Testing a Fuse is often desirable in order to know whether or not it is in working order. Since two fuses are usually placed in a circuit, one may "blow" and the other may remain unaffected. Your great concern is to find out if they are both useless, or just

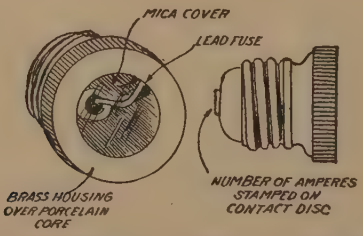


Fig. 174. Details of a Common House Fuse.

one, and which one. This determined, you can make immediate replacement.

Such testing can be done in several ways. The simplest way is to gaze through the mica top of the fuse and note if the lead fuse-wire is intact, as shown in the diagram of *Fig. 174*. If the fuse-wire is melted it will show that condition very clearly.

Another method, not dependent upon eyesight, is that of using a bell and dry-cell, as in *Fig. 175*. In this case one wire is connected to the bell and the dry-cell and another wire to the bell only. Touch the loose ends of the wires to the fuse plug in the manner illustrated—one wire to the shell of the plug and the

other to the disc of its metallic core. If the bell rings, the fuse is good; if it doesn't ring, the fuse has been blown.

Fuses in the Home are so arranged that they are mounted in sockets fastened to a switchboard. This switchboard is placed at the point where the power wires enter the house. This is a great convenience in case you wish to shut off the current in the

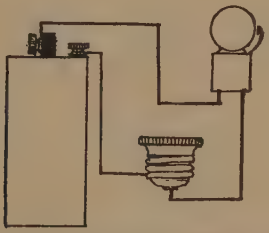


Fig. 175. Testing a Fuse Electrically when the Eye Cannot Tell if it Is Defective.

building so that you can do repair work; all you have to do is to throw open the switch. It is also a fine safety measure; for, if a charge of lightning, or other accidental strong flow of electricity, should come in from outside, the fuse or fuses will blow and automatically halt the incoming electrical stream before damage to the internal portions of the building can result.

When Replacing Fuses great care must be exercised. The entrance switch (see *photograph,* 276) should always be opened; one hand should be used for screwing down the fuse, and the other hand should not touch any kind of metal connected to the ground.

Heater Circuits, in their elemental form, have already been touched upon. It will be well now to take up some of their more important details.

The terminals of a heating element are attached to pieces projecting out through the heater frame. On these an attachment is pushed which makes connections between the heater terminals and the wires in an extension-cord. In this cord (*Fig. 176*) a switch is

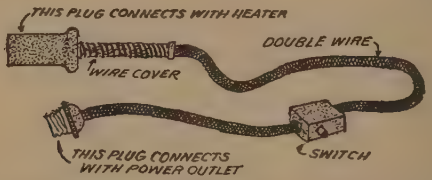


Fig. 176. The Extension-Cord Commonly Used with a Heating Apparatus.

sometimes placed if the plug at the other end of the cord is to connect with a wall receptacle or outlet for the current; but if the plug is to connect with an electric-light socket, the switch of the socket may serve and no special switch will then be required.

But, when a lamp socket is used for receiving the extension-cord, it would be impossible to use the lamp and the heater at the same time—as would be required at night—if there were only one socket for both. In such a case, provide yourself with a two-way socket, such as shown in *Fig. 177*. This is an inexpensive receptacle which will screw into your single socket and at the same time provide two outlets to use in any manner you please.

Extension-cord Repairs are sometimes needed. When the attachment is pushed into place on a heater,

and the plug at the other end of the cord is screwed into its receptacle, about twelve different connections are put into play. There is always a possibility that one or more of them will become loose or disconnected and cause the heater not to function as it should. The removal of a couple of small screws will give ready access to all these parts and a screwdriver will soon

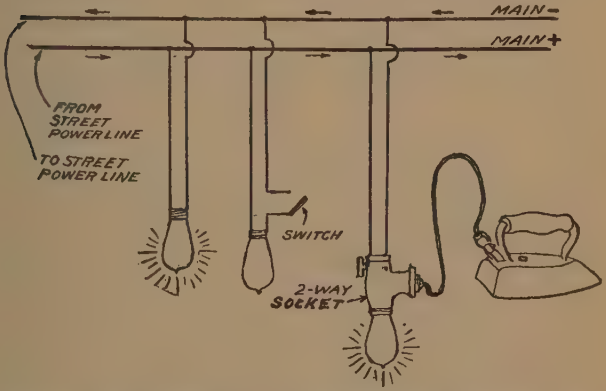


Fig. 177. The "Mains" of a House-lighting Circuit Are Like the Terminals of a Battery, in that They Are the Source of Power.

tighten loose ones. If any parts are broken or burned out, the dealer will furnish others and you can install them.

Heater Troubles may come from any one or more of the following defects: A fuse may have been blown. The power may be shut off at the supply station or the switch. The heater terminals may be dirty or burned off. The extension-cord plug may not be screwed far enough into the socket to make contact. Strands of

two wires may be touching each other, causing a short-circuit. Connections to the switch may be faulty. One of the cord wires may be broken. The heating-element may be burned out.

Fig. 178 shows two forms of attachment-plugs commonly used with extension-cords. One of these, *A*,

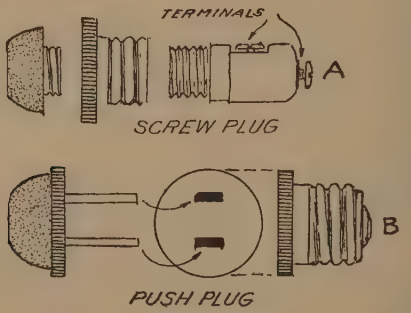


Fig. 178. Two Common Kinds of Plugs Used on Extension-Cords.

connects with a socket by a screwing action; the other, *B*, connects by friction and is pushed into position. The latter type—or push-plug—has the advantage in quick engagement and disengagement. Both are easily taken apart for wiring purposes, the removal of the shell giving access to the terminal screws.

Electric Lamps depend upon the heating effect of electrical current for their operation. Visible within the glass bulb is a fine wire called a filament, which is heated white hot by the current, thus projecting light rays.

The electricity is led into and out of the filament through two short platinum wires contained in the

solid glass core in the lamp's neck. These platinum wires are connected to copper wires which, in turn, are fastened to the brass collar and metal center of the neck. When the lamp is screwed into the socket, the current passes through the loop thus formed and the filament of the lamp becomes charged with light-giving power.

To Select Proper Electric Lamps for your home, you must be governed by the markings on the little paper pasted at the neck of the lamp. If your circuit is one of 110 volts, as most all home lighting circuits are, the paper should be marked "110v." You will also find upon all lamps another notation—namely, the wattage. If, for instance, you have been satisfied with the brilliance of a certain lamp marked "40w.," but wish to replace it with a new one, be sure to get a lamp marked in the same number of watts. If you wish a brighter lamp, either put on a better reflector or add a lamp of higher wattage, say 50 or 75 watts. This term designates the amount of power required to make the lamp burn at its highest point of efficiency. A 75-watt lamp requires just five times as much current as a 15-watt lamp, and is therefore just five times as expensive to operate.

To Tell if a Lamp is Burned Out, you cannot always go by the fact that it does not light up. Other causes might prevent the lamp from working while it was in perfect order itself. As an example, the lamp may not have been screwed far enough in the socket to make proper electrical contact. Or the power may be shut off. Or the socket into which the lamp goes may be deranged.

Before taking anything apart, however, when a lamp does not light up, first satisfy yourself that the current is on and the lamp properly screwed up in the socket, then remove the lamp and hold it up to the light—a window or another lamp—and look closely at the filament. If one of the strands is broken (*Fig. 179*), you ought to be able to observe it. In that case you

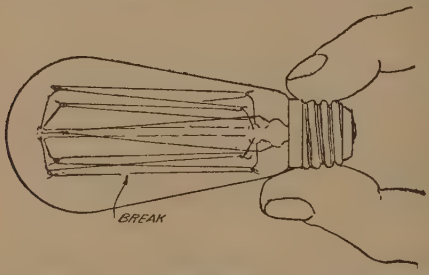


Fig. 179. Hold Lamp to the Window to See if Filament is Broken.

must either buy a new lamp or affect a temporary repair.

To Repair a Broken Lamp Filament, put the lamp in the socket and turn on the current. Tap or swing the bulb gently, in an effort to jar the severed filament ends together. If you can cause them to touch and cling a moment, the circuit will be reëstablished; the filament will glow and the heat will weld together the touching ends.

To Repair a Defective Socket Switch, take the socket apart with a small screwdriver and look for the trouble. Sometimes you will find it in loose screws, which can be tightened; sometimes in a bent lug, which can be straightened. If, on the other hand, the switch

points are worn off, it is advisable to get a new socket or to get around the use of a switch by unscrewing the lamp enough to throw it out of electrical contact, when you wish to turn it off.

Switch Troubles may arise at any time. You should be sure that both the wall switch and the key switch in the socket are closed before expecting any lamp or heater device influenced by them to operate. A push-button switch is closed when the white button is pushed in, and a key switch usually snaps when it is turned off, making no sound when it is turned on.

If the wall-switch connections of a home circuit should be loose, it is possible for the mere jar of a closing door to cause the lamps to flicker or to go out entirely. In such a case, remove the switch cover and fasten the wires firmly under the screws. These wires are in plain view, and such an adjustment can be made without danger.

Table-lamp and Floor-lamp Troubles may also occur when least expected, and may need prompt attention if the affected lamp is to be used again that same evening. If the bulbs do not light, try them on another lamp. If they light there, it shows a defect in the wiring of the lamp, or in the extension-plug connecting it to the main wires.

Test the wiring of the lamp sockets by removing them and examining their connections. (*Fig. 180* shows the parts of an ordinary lamp socket.) If all right, replace them on the fixture, and pull out some of the extension-cord from the base of the lamp. This will give you a chance to examine the tape-wound joint at this point. Remove the tape, and make sure the

splicing of the wires is as it should be, with good contact. Then rewind the tape and pull up the loose cord.

To Wire a Lamp and connect it to the house circuit mains, you are asked to inspect the diagram shown in *Fig. 181.* You will note, at *A,* that the service wires are connected to an intermediate wall or floor recep-

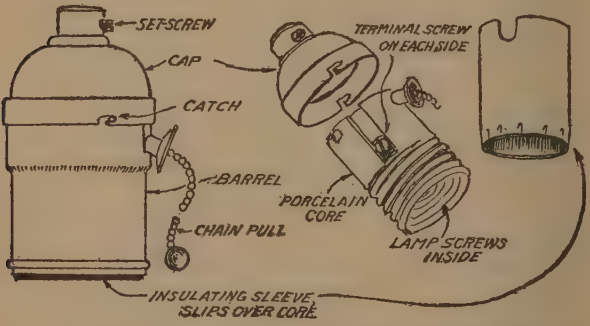


Fig. 180. How to Wire a Chain-pull Lamp Socket.

tacle. Into this socket fits a plug to which are attached the silk-covered wires leading into the base of the table-lamp or floor-lamp, as the case may be. In the base a joint may be affected, so that smaller and plainer wire can be utilized for wiring up the lamp proper, but such a joint is not necessary.

The lamp wires are "fished" through; that is, a small wire is pushed through the standard's hole from above, the lamp wires are attached temporarily to it and are then drawn up through the standard by aid of the wire.

If you have two bulbs, and wish them to operate independently of each other, wire them as shown at *A.*

If you wish to have both lights go on and off together, follow the wiring plan of *B*. The former method is the common wiring plan. This makes it necessary to run the lamp wires to one bulb, while two short connections go to the other bulb. In the *B* method, or

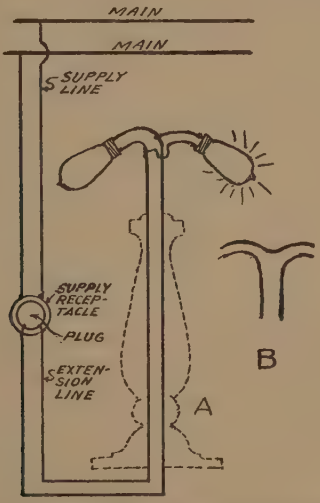


Fig. 181. Wiring a Table-Lamp, or Floor-Lamp.

series connection, one lamp wire joins one bulb and the other lamp wire the opposite bulb, a third short wire connecting both lights.

To Operate Two Lamps from One Outlet, as from a wall or floor receptacle, insert a two-way plug in the receptacle; then connect your extension-cords to the two branches of the special plug.

Other devices, such as heaters, can also be connected in with other electrical apparatus by using a two-way

or three-way plug in connection with a common outlet. This saves the installation of additional wall or floor receptacles and a lot of trouble in taking up baseboards and floorboards.

Wiring in Occupied Houses is the most difficult kind of work, because the plastered walls and floorboards present quite an obstacle in the way of concealing the wires. When they have additions to make to the existing electrical system, some home-owners, for this reason, prefer to run cotton-covered wire along the picture-molding, and down the corners, of a room, rather than go to the trouble of tearing out woodwork and replacing it.

However, as a rule, it is better to do your wiring in a neat manner, concealing it under the floors and between the studding; for such jobs can be done without materially damaging the finish of the boards or plaster, by the method of "fishing," already described.

Baseboards can be pried out with a chisel; flooring can have segments removed with a keyhole-saw and afterward replaced by toe-nailing (see Chapter VI); holes for porcelain tubes can be bored with a brace and bit, passing through joists and studding; the main wires can be tapped and the branches fished down or up—using strong cord and a small weight attached—and holes can be cut in floors and walls for the outlet boxes of the receptacles. In this connection, it should be borne in mind that baseboard and floor outlets are more easily fed from branch mains under the floor; that ceiling and side-wall outlets naturally belong on the circuits in the floor above.

The Code of the National Board of Fire Under-

writers contains, among others, a provision that no house circuit shall carry more than 660 watts. Assuming each lamp to be a 50-watt size, a circuit would thus be limited approximately to thirteen lamps. This would necessitate, were there more lamps, at least two circuits, which would mean two branches entering the house from the entrance switch-board, each branch controlled by its own switch and own set of fuses. If a circuit has a length of one hundred feet or more, nothing smaller than No. 14 wire should be used. It should be enclosed in loom or armored cable; the insulated wires should be supported by split knobs and porcelain cleats, and the cable upheld by metal straps.

Fig. 177 shows how lamp and heater devices are branched in from the mains of a common house circuit.

The Danger of Electricity is greatly magnified by people in general. In a home circuit there is really little chance at all of being harmed by this mysterious fluid. Even should you be so careless as to touch parts of the circuit and make a conductor of your body, you would be only mildly shocked; for the home circuit of 110 volts could not produce serious consequences unless, by some rare combination of circumstances, you should touch a live terminal while standing on damp ground or in a partly filled bathtub.

XX

SHOE REPAIRS

As the price of shoes has steadily increased, there has been a corresponding increase in the sale of home cobbling outfits. A medium-priced shoe may often be in good enough condition to be worth heeling and half-soling a couple of times before it has to be thrown away, and because the work of repairing is not difficult to do, and the saving of time and money is considerable, many folk are turning cobblers under their own roof. To-day we even find mothers and older daughters fixing up their own shoes and the children's when big brother and daddy are away, and from this thrifty task they gain a very pardonable, well-deserved pride.

The average cost of heeling and soling a pair of shoes at home will be about 40 cents. When you stop to consider that the professional shoe repairman will charge $1.25 for the same job, you cannot wonder at the growing popularity of home repairing, which takes very little time and can be done in spare moments.

A Shoe Repairing Outfit is a very simple affair. A very good one can be purchased for about $2.50, and it will last practically a lifetime. If your town does not contain a hardware store that carries these in stock, select an outfit from one of the big mail-order catalogs of outside firms. Additional supplies, such as nails, thread, and leather, can be secured, when needed, from the same source.

BEFORE THE HOME COBBLER USES HIS TOOLS.
COULD SHOES LOOK WORSE?

AFTER THE HOME COBBLER GETS BUSY; NEW SOLES
NEW HEELS. FINE!

A good home outfit (*Fig. 182*) may be said to cover the following items:

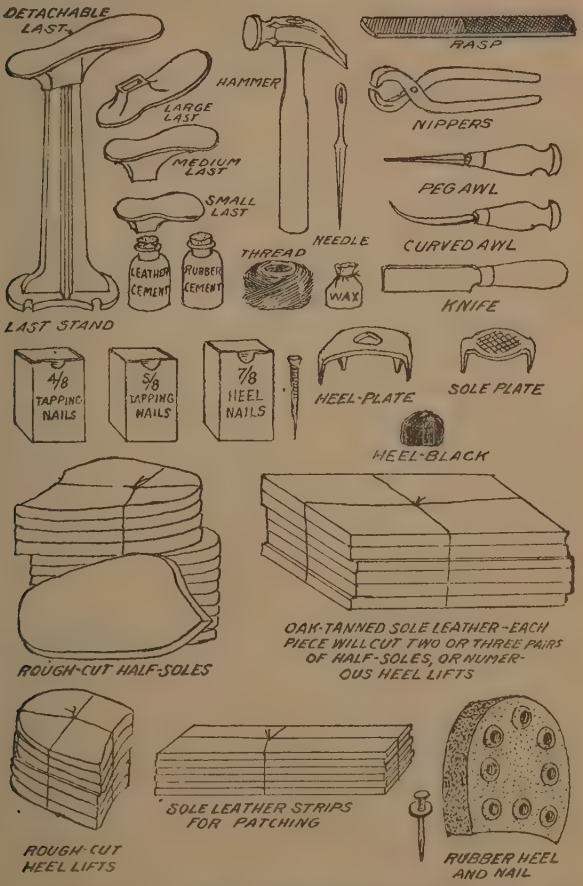


Fig. 182. Tools and Supplies Recommended for Home Shoe Repairing.

1 14-inch last-stand,
4 lasts,
1 shoemaker's forged hammer,
1 shoe-knife,
1 patent peg-awl handle and wrench,
1 peg-awl,
1 sewing-awl handle,
1 sewing-awl,
6 shoe needles,
1 black heel ball,
1 oz. leather cement,
2 ozs. rubber cement,
1 2-oz. ball shoe thread
1 ball of cobbler's wax,
1 pound of heel nails,
½ pound 4-8 tapping nails,
½ pound 5-8 tapping nails,
4 pairs of heel plates,
1 shoemaker's rasp,
1 pair of nippers.

The Parts of a Shoe are illustrated in *Fig. 183*. These—and the distinguishing features of a nailed and a sewed shoe, *Figs. 184* and *185*—should be learned by every person concerned in repairing shoes, since he will understand his work much better.

Common Thread can be used for sewing shoes if you get it of the right weight and composition. Do not accept "linen finished" thread, as that is only an imitation linen; ask for genuine linen, size from 25 to 40.

Waxed Shoe Thread, however, is the best thread for sewing leather, as it is prepared especially for shoe or harness work. It can be had in various sizes, to suit the task. This thread is very strong, a grayish yellow color, and is coated with wax to make it waterproof and adhesive to the leather.

To Make Waxed-ends, as the shoemaker calls his hand-made threads, secure a spool or two of shoemakers' flax thread; then proceed in the following manner:

1. Take the end of the thread in the left hand and draw out a required length—at least five feet.

2. With the thumb and index finger of the left hand, hold the thread firmly at the end. Untwist the

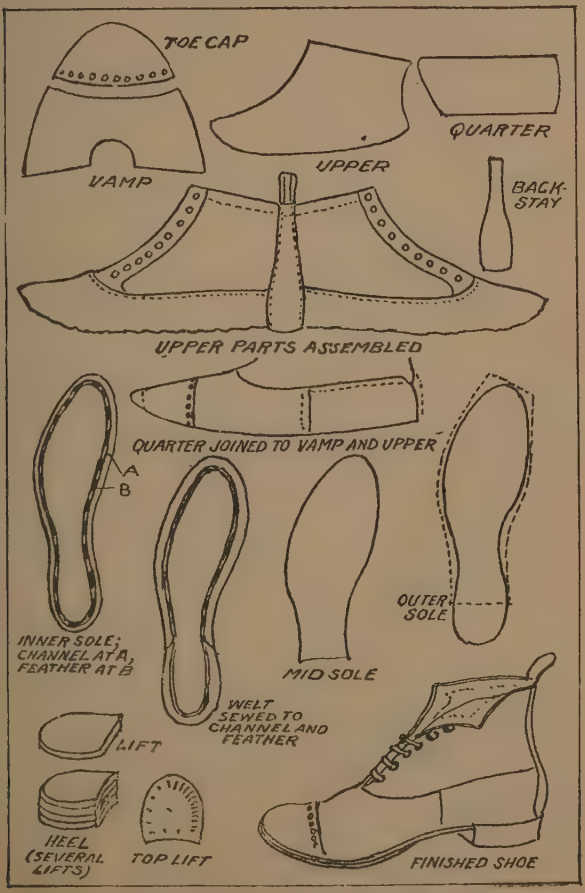


Fig. 183. The Parts of a Welt Shoe.

thread by rolling it on the knee or right thigh, using the palm of the right hand. Watch carefully and stop the untwisting when all the twist is out of the thread in the 6 or 8 inches of thread next to the left hand. Hold the thread between the thumb and finger of the right hand at the farther end of the untwisted portion.

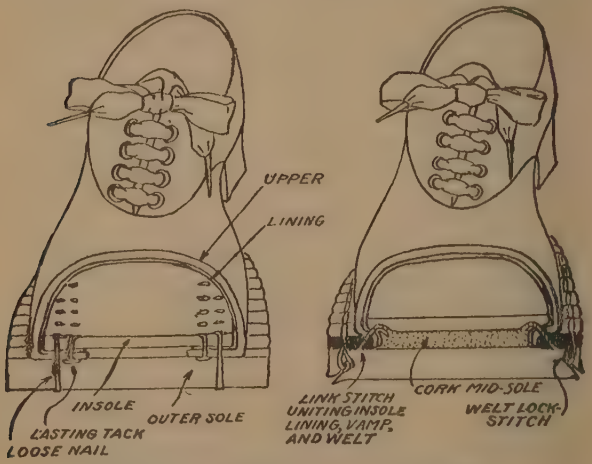


Fig. 184. Cross-section of a Nailed Shoe.
Fig. 185. Cross-section of a Sewed Shoe.

With a quick jerk, break the thread at this point. It will tear apart easily and unevenly. The unevenness is desirable, as you will note later.

3. Pull the thread strands out so that the fibres will taper, or, in other words, so that one strand end projects slightly beyond its neighbor, leaving a very fine point.

4. Double the thread, placing the looped end over a hook fastened to the wall. Draw the thread out

tautly, while you hold both ends in your left hand. With the ball of wax in your right hand, rub the wax along over the strands until all are well coated.

5. Holding the thread against the leg, as in *Fig. 186*, roll first one section then the other until the entire

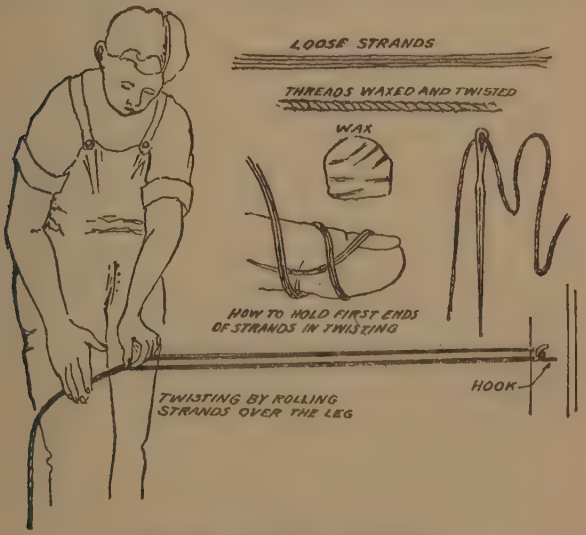

LOOSE STRANDS
THREADS WAXED AND TWISTED
WAX
HOW TO HOLD FIRST ENDS OF STRANDS IN TWISTING
HOOK
TWISTING BY ROLLING STRANDS OVER THE LEG

Fig. 186. Making a Waxed-end.

thread is closely twisted. Then go over it once more with the wax, being careful to have a neat taper at each end. If the thread has flat surfaces, it is an indication that it has not been twisted sufficiently; it should be round and smooth.

To Thread the Needle, work the pointed end of the thread through the eye of the needle until it projects about 2 inches. Then bend down the fine point

against the main thread, and twist it into the wax of the latter by twirling the needle between the thumb and finger of the right hand.

Leather for Shoe Repairs can usually be obtained locally, from a shoemakers' supply store, from a hardware store, and very often from 5-and-10-cent stores. If you do fail to secure it in your home town, however, you are sure to find it listed in a mail-order catalog.

Sole Leather is the thick, hard leather composing the soles and heels of shoes. It can be bought either in roughly shaped soles and heels, or in squares and strips from which you can cut out your own parts. For family repair work, the strips and squares are the most economical method of purchasing, as the formed parts are uniformly of one large size, and there is consequently considerable waste where you have to cut children's soles and heels from such pieces.

There is a great difference in the quality of all leathers, shoe leathers as well. Oak-tanning makes the best heel and sole leather for ordinary wear; chrome-tanning produces a water-proof leather. The pieces should be close-grained, free of cracks, and the average bundle of one dozen heels or soles should measure 5 inches through. If thinner than ⅜ of an inch, a strip of sole leather is likely to be a "split"—a section of an entire hide thickness, and is not considered to be high-grade.

Top Lifts, as heel pieces are called, sell for about 6 cents per pair. By the dozen pairs they can be had for about 68 cents.

Half-soles, which are really not half of a sole in any way except lengths, will cost you possibly 25 cents per pair, or $2.90 per dozen pairs.

Upper Leathers are the leathers from which the thinner leathered portions of a shoe are cut. It is not likely that you will require new leather of this kind, as you will only occasionally need a piece at all, and then only as a patch for a shoe you are trying to save. For this reason, I would advise you to save the tops of old shoes when you quit wearing them, and cut your repair pieces from such tops.

Sewing Rips is one of the easiest of shoe repairing jobs. The holes for your needle are already made through the leathers, so all you need to do in such cases is to put your waxed-end in the needle after the manner previously described, then follow the trail of the former machine sewing, skipping holes uniformly if they are too close for your hand stitching, and drawing each loop down to the leather as you proceed. In beginning to sew, start back in the bound edge about ½ inch; and, in finishing, carry your sewing on past the rip for another ½ inch. Do not knot the thread; merely cut it on the inside.

Sewing in New Leather is a little more difficult. Here you must first punch your leather with the sewing-awl, then start out from underneath, drawing each loop closely down, keeping the two pieces of leather in firm contact.

To Stain the Thread the color of the shoe you have sewed brings the final touch. The staining can be done with a small brush dipped in liquid shoe polish of the same color as the shoe.

Applying Leather Patches is seldom required, yet there are times when a patch neatly put on a shoe with a bad cut in it will postpone the purchase of a new pair for quite a long period. All you will need are: a sharp shoemaker's knife, a piece of suitable leather, a bit of medium-grit sandpaper, and a bottle of leather cement.

The leather ought to be rather thin. Cut it out in a form that will give you round corners; as a rule, a circular piece looks best. Skive (bevel) off the edges, all around, on the under side of the patch, so that the extreme outline itself will be as thin as paper. Sandpaper the entire under side, to remove all grease, dirt, and roughness.

Lay the patch on the shoe, over the abrasion, and mark around it with a pencil. Scrape the surface of the shoe with a knife until all blacking or enamel is removed, then sandpaper it until it is clean.

Apply a coat of the leather cement to the under side of the patch and the scraped surface surrounding the blemish. Let these coats stand about 2 minutes, to allow them to soak into the leathers. Then apply another thin film of cement to each surface. Permit this to stand 1 minute, until it becomes very tacky. Place the patch upon the shoe; press it firmly with the fingers, to insure a good contact with the shoe; lay a weight upon the patch; and in 30 minutes the job will be dry and the shoe ready to wear.

To Repair Damaged Eyelet-hooks—if the hooks are merely jammed so closely together that you cannot force the lace in—remove the shoe from the foot, place it on a suitable last, insert a screwdriver under the

affected hooks, and pry them out to their normal position.

If a hook should get bent outward too far, force it back with a hammer or pair of pliers.

If a hook tears out of the leather, pry open the closed clinching prongs of the hook, reinforce the torn hole by cementing on the under side a strip of thin leather, reinsert the hook, then rerivet it by driving a center-punch in between the prongs and bending them backward far enough for a hammer to finish the clinching.

If hooks get brassy by reason of the enamel wearing off, it is an easy matter to purchase a half-pint can of enamel of the color desired, and then recoat them. Let the enamel dry two days.

Broken Laces should be replaced with good ones as soon as possible; but emergencies arise when they must be repaired some way or other. The fact is, if you are careful about it, you can tie together the broken ends of a shoelace in such a manner that the splice will show very little, if at all, and repair the lace so that it will continue to give excellent service for some time.

To make such a repair, neatly tie the ends together while the lower section of lace is laced up, making a flat knot which will lie under the edge of the lace-stay; then proceed to thread in the other section of lace.

Removing Projecting Nails has bothered many a luckless shoe-wearer; in truth, four persons out of five will suffer a good many holes in socks and stockings, as well as no little physical discomfort to themselves, before they will take the trouble to carry the offending

shoe to a professional cobbler and ask him to remove the troublesome little nail. Usually they feel helpless to do the task themselves.

There are two ways to remove such an obstruction, which generally results from a wearing down of the sole or heel and a consequent gradual inward advance of the nails holding it on. One method is to place the shoe on the last, with sole turned up, and to strike the heel or sole with a hammer just above the nail. This will bend over the outcropping point and force it well into the inner-sole of the shoe, where it will be harmless. The other method is to set the shoe on its sole, insert a pair of nippers, and with them cut off the projecting nail close to the leather.

To Stretch a Tight Shoe the usual process is to dampen the shoe by placing wet cloths over it, then insert a rounded stick as large as your wrist, and work this up and down, crowding at the portion where stretching is desired until the leather gives sufficiently to render comfort to the wearer.

Sometimes, owing to foot injuries causing swellings, it is necessary to slit a shoe immediately over the swelling in order to give footwear relief to the wearer. In such cases, make the cut in the form of a plus symbol —two slits at right-angles with each other—and if the owner of the shoe desires the job to be the maximum of neatness, afterward cement a thin disc of leather to the shoe, covering the slits, but leaving them somewhat open so that the patch will have some fulness, being caught only near its edge.

To Get Relief from a Loose Shoe, either insert a pair of " store " insoles, which can be had for from

15 cents to 25 cents, or have the owner wear heavier stockings.

For Broken-down Arches, the shank of a shoe must be made very stiff, yet elastic. Without the latter virtue, the wearer's instep would soon become very sore. Arch-supports are fixtures which can now be bought of dealers in shoe supplies. They are made, as a rule, of leather reinforced by a steel spring, and may be had in various sizes to fit all shoes. Manufacturer's directions for insertion in the shoe come with each pair of arch-supports.

To Stop Shoes from Squeaking is not always an easy matter. This defect is caused by a chafing of the inner and outer soles. A temporary relief is secured by setting the shoes in a basin of water so that the soles only are immersed. Leave them 30 minutes, then set them aside in a warm place for drying.

A better way to stop the squeaking is to drive a few nails in the part of the sole where the friction seems to be taking place—usually around the ball of the shoe. Inspect the inside of the sole for protruding nails, and clinch any such which may be found.

Run-down Heels are a common sight, and no condition of a shoe does more to tire a person or, if continued for a long term, to deform the ankle and induce a slovenly gait. Every effort should be made by the wearer to have his heels kept up in a level condition. And, inasmuch as there is scarcely any portion of a shoe that is more easy to repair than a heel, it would seem almost criminal to neglect such important parts of our apparel.

Heels are not always made of layers of thick leather,

as many of us might suppose. Only the better shoes are thus made. The cheaper ones are composed of but one solid piece,—the top lift,—under which is a bed of leather scraps firmly pressed together with cement. The scrap portion does not wear well; nor does it hold nails well, which accounts for many top lifts of such heels pulling off before they are worn down.

To Repair a Run-down Heel (*Fig. 187*) take an old chisel and pry off the top lift and any others below

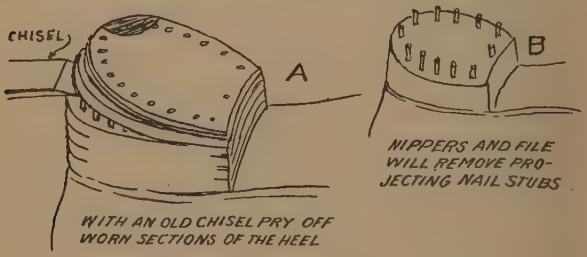


Fig. 187. Repairing a Run-down Heel.

which show uneven wear. (See *A*.) Nip off the projecting nails, as at *B*, and file them down flush with the leather. The old heel is then ready to receive new leather.

If your stock leather is already cut out to the rough heel shape—in other words, if it has been bought as heel lifts—soak as many lifts as you will require in warm water until the leather bends easily. If your leather is in sheet form, lay the old heel upon the leather and trace around the heel with a soft pencil, cutting ¼ of an inch beyond the outline with your

shoemaker's knife; then soak the pieces as in the other case.

Lay on one of the lifts; punch, with an awl, three holes for heel nails—one hole near each forward corner of the heel and one in the center of the bulge at the back. Drive these nails down, being careful to note before striking them that they are headed so as not to come out of the side of the heel. Then add several more nails, and trim off the surplus leather with the knife.

In the same manner add the top lift of the heel. When this has been neatly trimmed, gauge a pencil line around the top lift ¼ of an inch in from the edge. This is a guide-line for the remainder of the nails. Punch for these, placing the holes quite close on the side of the heel which the wearer wears down first. Then drive in all the nails, this being done on the last, of course. Do not neglect to put a few nails in the central portion of the heel. Then make a close inspection for projecting nails, inside and outside.

Use the rasp to shape off the edges of the new pieces to conform exactly with the outline of the old heel. Finish the edges with sandpaper. When smooth, black the edges with a black writing- or burnishing-ink, using a small brush. When dry, rub on some heel ball. Polish with a cloth, and you will have a new-looking heel.

Plating Heels is a preventive measure against a run-down condition. Some people set their feet down so much out of level that they would wear off new heel leather almost as fast as it could be put on if there were not something harder than that material

which could be put over it where the heaviest wear came. For such troubles, you can buy metal heel plates of various shapes and sizes, and they are very inexpensive and easily put on if the heel has not been run down too far. If it is in bad condition, the proper

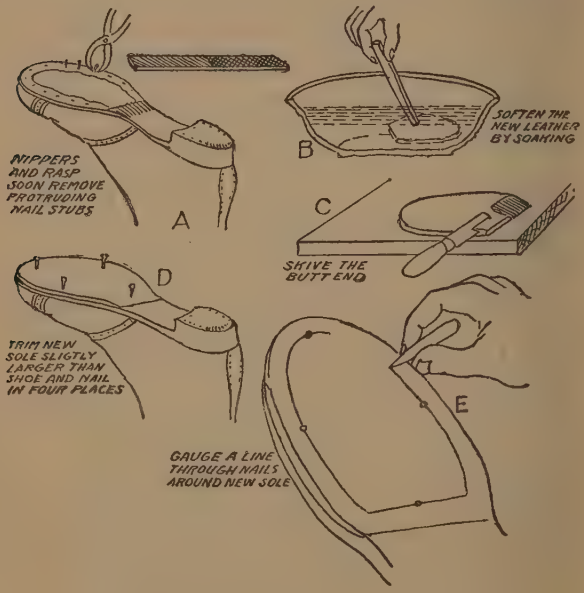

NIPPERS AND RASP SOON REMOVE PROTRUDING NAIL STUBS
A
B
SOFTEN THE NEW LEATHER BY SOAKING
C
SKIVE THE BUTT END
D
TRIM NEW SOLE SLIGTLY LARGER THAN SHOE AND NAIL IN FOUR PLACES
E
GAUGE A LINE THROUGH NAILS AROUND NEW SOLE

Fig. 188. Putting on the New Sole.

thing to do is to build up the heel once more with leather, after the manner shown previously, then apply the protective plates. These have sharpened prongs made upon them, and all you have to do is to place the plate in the position desired and hammer it down against the leather.

Plating Soles is also often resorted to, especially in boys' shoes. Shoe supply dealers sell very neat little metal plates for reinforcing soles. These are usually pronged, as with heel plates, and are attached in the same manner.

Half-soling a Shoe is just about the same process as building up a run-down heel, the chief difference being that it takes a little longer to do it.

After cutting out a pair of half-soles of the proper size, soak them thoroughly in lukewarm water, as at

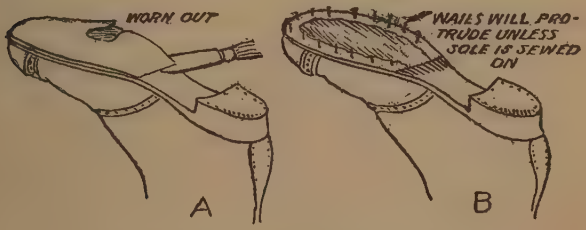


Fig. 189. Removing the Worn-out Sole.

B, Fig. 188. Hammer them on an old style flatiron or on the bottom of a large-sized iron last, to make them firm and solid.

Skive (thin) off the shank or butt end of the sole, as at *C, Fig. 188.*

Put the shoe on the last which most nearly fits it, and with an old chisel or butcher knife pry off the worn outer-sole, as at *A, Fig. 189.* Nip off all projecting nails, as at *A, Fig. 188,* and make the sole as smooth as possible with a rasp.

Place the new half sole in position, and, with the peg-awl, make holes for four nails, about ⅜ of an inch

inward. Have one hole at the toe end, another at the shank end, and another about midway of each side, as at *D, Fig. 188*.

Remove the shoe from the last, and trim the sole edges flush with the inner-sole, but be careful not to undercut. The leather, being damp, will cut easily.

Gauge a line (*E, Fig. 188*) around the sole about ⅜ of an inch from the edge. This nailing guide-line can be made in several ways. One method is to grasp a pencil so that the thumb end will act as a gauge head.

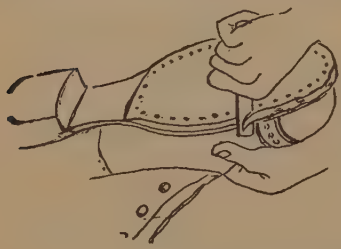


Fig. 190. Completing the Nailing.
Fig. 191. Trimming.

Another way is to set a compass or divider to a radius of ⅜ inch, let one leg drag along the edge of the sole and keep the lead or point of the other leg upon the new leather.

With the peg-awl, make shallow holes all along the guide-line, having the holes about ⅜ of an inch apart. The easiest way to space these uniformly is to set a pair of dividers to the measurement named, and step off the positions, pricking each one as you go.

Hammer the nails home (*Fig. 190*). In driving, it is customary to slant the nails a trifle toward the center

so that there will be no risk of them coming out of the uppers on the outside. Each nail should pass entirely through the inner-sole, should strike the last and clinch over, and should be slightly buried in the under leather. Make sure that the edges of the sole are down tight; if they are not, continue to pound until they are.

The final trimming (*Fig. 191*) can then be done, using the shoe-knife for the purpose. Use the rasp, if it is needed; finish smoothing with sandpaper. Black the edges with writing- or burnishing-ink; dry them, and apply some heel ball. Rub the heel ball coating with a soft cloth, until a good polish has been secured. The job is then done.

Attaching Rubber Heels is another job that may confront the home cobbler; for rubber heels are a very popular type of heel, and most people who have used them prefer them to the leather form. There is no question as to their reducing the jar put upon the body when walking; they produce an almost noiseless shoe in striking, and they seem to wear about as long as the average old-fashioned sole-leather heel.

The first step in attaching rubber heels to shoes having leather ones, is to remove enough leather lifts of the old heel to equal the thickness of the rubber heel. Pry off the leathers with an old chisel (*Fig. 187*), cut off the projecting nails with nippers, then file them, making the leather surface perfectly level.

The new rubber heels already have holes in them, and as a rule the proper nails are supplied when you purchase the heels. So if the heels fit the outline of the old heel, as they should, all you have to do is first

to drive down the corner nails, follow with the others, then set the nails down to the metal washers just below the surface by using a carpenter's nail-set or a heavy nail whose point has been ground down blunt.

If there is any projection to the rubber heel after it is nailed on, or any projection of the leather, trim this off with a keen knife, and smooth with sandpaper, afterward rubbing on heel ball and polishing. Where it is impossible to get rubber heels of a size to fit exactly the contour of the leather heel, select a rubber heel slightly larger than the leather one, and pare it down after attaching.

To Patch Rubber Footwear, you will need some patching rubber, a small bottle of rubber cement, and a piece of sandpaper. With these materials it is possible to repair a leaking overshoe or boot so that it will be as water-proof as when new and almost as good looking. The patching rubber can be secured from a shoe shop or mail-order house; the rubber cement likewise, or from a bicycle shop.

First, cut out the patch you wish to apply. Have it of circular form and somewhat larger than the hole or cut you are to mend. Skive off the edge with a sharp knife.

With gasoline or sandpaper, remove all dirt and grease from one side of the patch, also from the surface of the footwear which the patch is to occupy.

Apply a thin coating of the cement to both cleaned surfaces. Let them stand about a minute. Then apply a second coat of cement. In about 30 seconds, place the tacky surfaces together, pressing down firmly with the thumbs. Lay on a weight.

In from 30 minutes to an hour the footwear will be ready for hard service.

To Water-proof Shoes or Boots, get a half-pint of neatsfoot oil at a shoe store or drug store, and rub the oil into the leather with the palm of the hand. Let the first coat dry about 30 minutes, then apply a second one. When this has stood a corresponding length of time, remove any surplus oil by a brisk rubbing with a soft cloth. Such oil, applied from time to time to any shoes or boots exposed to wet will not only render them practically damp-proof, but will keep them soft and pliable.

To Polish Shoes and Boots, you can use either a paste polish of the color desired or a prepared liquid dressing. The latter is applied with a brush or swab attached to the cork of the bottle, and it dries quickly with a good lustre, requiring no hand polishing. The liquid is much used by ladies, because of its simplicity of application. It is valuable, too, as a coloring compound for applying to new leather when making shoe repairs.

The paste polish, however, is more universally used for men's and boys' footwear. It should be kept closely sealed when not in use. All dirt and mud should first be cleaned from the shoe or boot with a brush or damp cloth, the leather dried, and the polish applied with a dauber-brush or a swab of soft cloth. Let the coat set a couple of minutes, then polish to a brilliant gloss by drawing a piece of soft cloth back and forth over it, one end held in either hand, with the shoe elevated upon a box or similar convenient resting-place.

XXI

HARNESS AND GLOVE REPAIRS

Thirty or forty years ago harness makers made nearly all of the harness they sold. This condition does not prevail to-day. Now they repair harness only, and, on account of the advent of the automobile, there is comparatively little of even that form of the harness business.

Most of the harness manufactured in the factories is sold to farmers, who still cling to the horse. The straps, under heavy loads, are always breaking, just as they did decades ago, and if a farmer does not know how to make the repairs himself he is put to a very great disadvantage, for it often means a long trip to the nearest town in quest of a harnessmaker.

It is my purpose, in this chapter, to describe and illustrate methods of making harness repairs such as are commonly required about the farm home, so that any handy man or boy will be able to meet the ordinary emergency calls arising from such breakdowns.

In addition to this, leather glove repairing will be treated, since the two subjects are very closely related, the ability to sew harness being equivalent to the ability to sew gloves, and certainly there are always plenty of leather gloves, in a state of disrepair, to be found on farms.

Harness Repair Parts are carried in most local hardware stores or harness shops; mail-order firms also handle them and are glad to send catalogs from which

to select. Inasmuch as the work of repairing consists largely of attaching the repair parts to the harness, only a few simple tools are required. For glove work, harness tools are sufficient.

A Harness Repair Outfit, aside from the fittings themselves, will consist of the articles shown in *Fig. 192,* with the exception of the glove finger-stick, which belongs exclusively to glove repairs. As you will observe, by comparing this assortment with that used in shoe mending, described in the preceding chapter, many of the items are similar, so that any one supplied with a cobbling kit will possess nearly everything needed for repairing harness or gloves. The needles are the same, for one thing; the awl may be the same, the wax the same, the knife the same, and the thread the same.

The Care of Harness requires that once each year it should be closely inspected, thoroughly cleaned with gasoline, dried, softened with neatsfoot oil, and neatly repaired. If this is done, the harness will not only last longer but will be less likely to break when time is valuable. The winter months are the farmer's most idle ones; therefore, they constitute his best period for repairing. As the work requires very little space, the harness can be taken out of the cold barn into the warmer rooms of the house and all mending done in leisure and comfort.

A harness consists principally of straps and connections. As a usual thing, it wears out where the straps are fastened to the connections. There are about a dozen places, of this kind, where breaks are likely to occur, and it is a good plan to keep on hand a few

extra fittings of each style, so that emergency repairs can be made without waiting to go to a distant town to purchase needed parts.

A Harness Stitching Clamp (*Figs. 192* and *193*) is not a necessity, but it surely is a great convenience

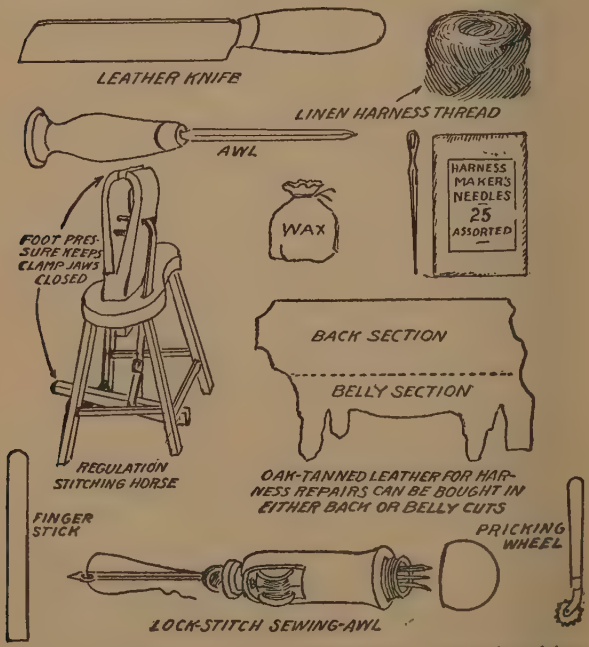


Fig. 192. Equipment for Doing Harness and Glove Repairing.

for holding the work while sewing. You can use an ordinary wood-worker's vise for the purpose—or a saw vise, if you have one;—but the harness clamp places the harness higher so that you can operate with less fatigue, in addition to which the device is not at

all difficult to make. The diagram in *Fig. 193* shows clearly how to construct such a clamp. Almost any kind of sound wood will do. The two jaws are held apart at the bottom ends by a spreader-block and are fastened with a leather hinge so they will close and open. The regular bench vise bears against the compression block, when the harness ends are in position,

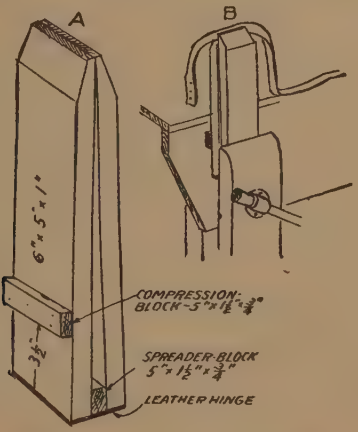


Fig. 193. This Harness Stitching Clamp Can be Made at Home.

and the bench jaws are tightened enough to cause the stitching clamp's jaws to clamp tightly upon the strap.

To Make a Harness Thread or Waxed-end (*Fig. 194*), consult the description given under the heading "To Make Waxed-ends," in Chapter XX, immediately preceding.

To Make a Stitched Splice, make a square cut at the ends of the two pieces of strap which you intend to join.

Skive off each end on the flesh or rough side of the leather. To do this, lay the pieces on a block on the bench, and, beginning about 2 inches back, bevel through with the knife to a thin edge. This job can also be done with a sharp chisel. (See *A, Fig. 194.*)

Lap the two pieces on their skived cuts, smooth

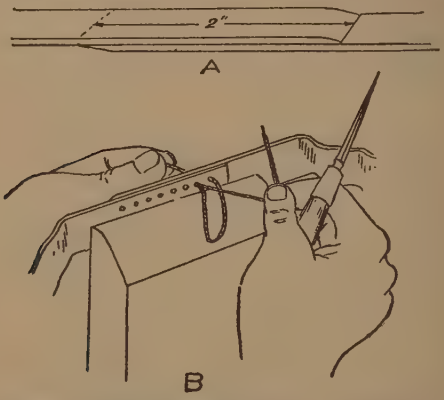


Fig. 194. Doing the Sewing with a Lock-stitch.

sides out, resting upon the bench. Guide the pricking-wheel along close to the edges, also across the strap, marking off the stitching holes the full length of the lap.

Place the straps in the stitching clamp, with the marked side at your right, as at *B, Fig. 194.* Having prepared the thread, and attached a needle at both ends, make a hole with the sewing-awl through the single strap farthest away from you, at a point just beyond the splice. Keep the awl in your right hand, and draw the thread through the hole so that an equal length of thread is on each side.

Make the second hole through the straps. Place the left needle in the hole and draw it out about 3 inches, then hook the hand over it and draw it about a foot.

With both needles and the awl in the right hand, pass the needle of the right-hand thread through the upper corner of the diamond-shaped hole, grasp the needle with the left hand and draw it through about 3 inches, then hook the hand over it and draw it through as far to the left as the other thread is to the right.

Keeping the needle and awl in the right hand, and the other needle in the left hand, grasp the threads with the unoccupied fingers and pull them up tightly.

Continue stitching in this manner until you have made the last stitch. The right-hand needle and thread are then passed through the single strap at a point one stitch beyond the splice.

Turn the strap end for end, and clamp it in place again. Cross the threads on the left side of the strap, then bring one thread through a hole in the single strap just beyond the splice, and proceed stitching as before.

To finish the stitching, place the left needle and thread through as usual, then place the right needle in the hole; when it is in this position, wind the left thread once or twice around the needle. Draw both threads up as tautly as before. This winding locks the threads in the leather. Another small hole is then made back on the splice at a point about ⅛ of an inch below the next to the last stitch, and the right-hand thread is passed through. Draw it up tautly, and cut off both threads close to the strap.

Pass the pricking-wheel over the stitching on the same side as before, pressing firmly. Trim the edges with the knife, so as to make them smooth. The appearance may be further improved by placing the splice flat on the bench or a metal surface and tapping the seam lightly with a hammer.

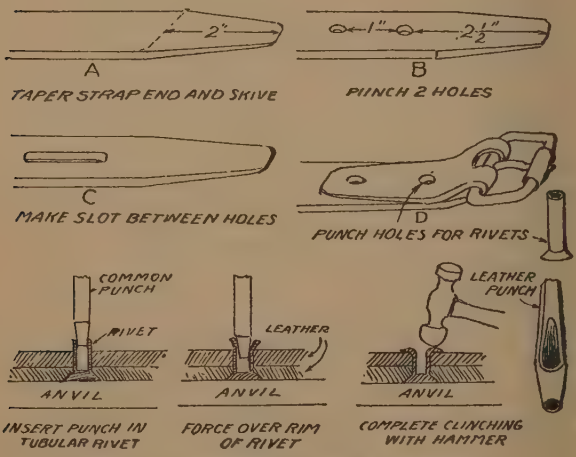


Fig. 195. Attaching a Buckle with Rivets.

The splice is finished by brushing on a leather stain (black writing-ink will do for black harness), allowing this to dry, then rubbing on a little heel ball, and polishing with a soft cloth.

To Attach a Buckle with Rivets (*Fig. 195*), place the strap on the workbench, with the rough or flesh side up, and skive off about 2 inches of the end. Also taper off the edges, as shown at *A*.

Punch two holes, with a belt punch or a peg-awl,

about 1 inch apart, the first one about 2½ inches from the end of the strap, as at *B*.

Fold back the end so that the holes will line up, and hold the lap down firmly with the left hand. Cut an opening in the folded end, to receive the tongue of the buckle, as at *C*.

Place the buckle in position in the strap, as at *D*. Insert the punch in the holes previously made and punch similar holes through the under portion of the strap.

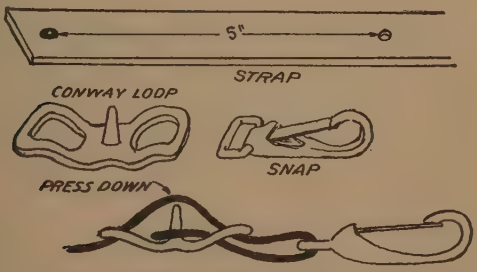


Fig. 196. Attaching a Snap with a Conway Loop.

Insert tubular rivets of the right length to clinch nicely. Reverse the strap so that the rivet heads will rest upon a flat metal surface, such as the bottom of an old flatiron. Force a large wire nail into the barrel of the rivets, and bend over the prongs far enough to allow you to hammer them down into the leather.

Blacken the unstained edges of the strap, and use heel ball for polishing.

To Attach a Snap with a Conway Loop (*Fig. 196*), punch a hole ½ of an inch from the end of the strap, also punch another hole about 5 inches from the hole at the end.

Place the strap through the Conway loop, then thread on the snap, passing the end of the strap back under and through the nearest loop to it, and forcing the pin of the Conway up through the hole in the strap's end.

Press down on the bulge of the strap so as to bring the hole in this portion in alignment with the pin of the Conway, and force the pin through this part of the strap also.

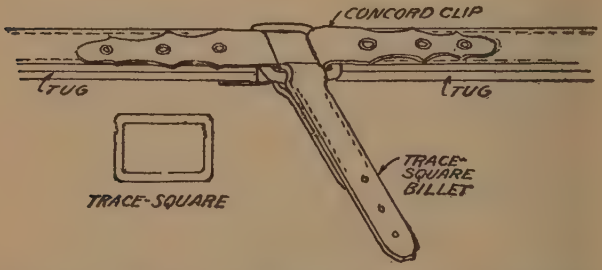


Fig. 197. Repairing a Broken Tug at Its Junction with the Trace.

Pull on the snap, which will draw down the loops of the strap and make everything flat.

To Repair a Broken Tug at its junction with the trace (*Fig. 197*), you will require a trace-square and two Concord clips.

Shorten the trace or tug, by cutting it, so that when the metal parts are inserted the total length of the trace will be no greater than before it or the tug was broken. The distance from the front end of the tug to the center of the trace-square should be 18 inches.

Place the square in the clip, with the end of the

trace also in position in the clip. On the trace mark the holes for the rivets.

Remove the trace, and punch the holes for the rivets.

Place the trace in the clip and the rivets in the holes. With the heads of the rivets resting against some sort of an anvil, force over the prongs of the tubular rivets with a large nail, and finish clinching the prongs by hammering them.

Fasten the other end of the tug in the same manner.

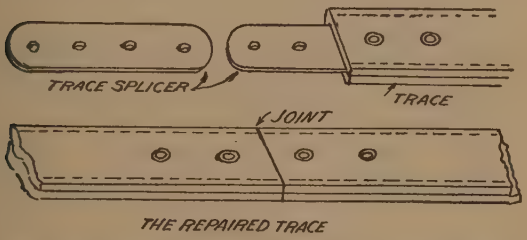


Fig. 198. Making a Strong Splice of a Broken Trace.

Sew a trace-square billet, 1¼ inches long, to the trace-square, else rivet it on, as you choose. The method of stitching has been described previously and illustrated in *Fig. 194*.

To Splice a Broken Trace (*Fig. 198*), square off the broken ends and place the new ends together.

Lay on them, in the position it is later to be attached, a regulation trace-splicer, which is a thin metal plate containing several rivet holes; if you have no such splicer and are in a hurry, make one out of a piece of sheet brass, forming the holes with a drill. Through the holes of the splicer, prick marks on the leather at the points where you are to place the rivets.

Remove the splicer and punch the holes through both trace ends.

Slip the splicer in between the folds of the trace ends. Select flat-headed solid rivets; place washers over their projecting ends, when they are inserted through the leather and splicer, then rivet them with a hammer.

If the edges of the trace are open, resew them.

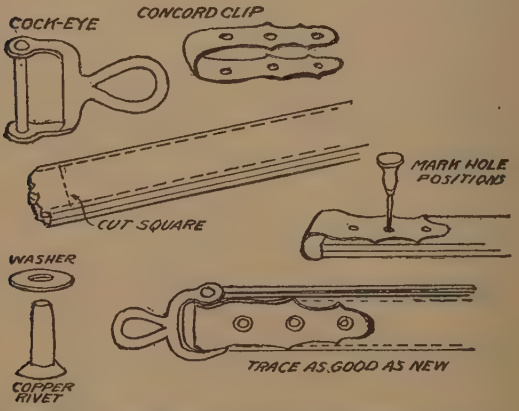


Fig. 199. Repairing the End of a Broken Trace.

To Repair the End of a Broken Trace (*Fig. 199*), cut the end so it will be square. Place the trace in the Concord clip and mark the holes for the rivets to be used. In doing this, see that the trace is kept far enough away from the cockeye to permit the latter to swing freely.

Remove the trace from the clip, and punch the holes.

Place the cockeye and the trace in the clip, and put the rivets in their holes. These rivets should be of the

solid type, with flat heads, and should be washered on the small ends.

Head over the rivets with a hammer.

Glove Repairs

Leather Gloves are used a great deal on the farm, because gloves get hard usage there and because there is no material for this purpose at once so tough and elastic as leather. A pair of leather gloves will last two or three times as long as they would otherwise do if their owner keeps them soft and pliable and sees to it that all rips are sewed up as fast as they start for even a stitch or two.

The Equipment for Repairing Gloves, as stated previously, is of the most simple and inexpensive kind. You will need two or three leather needles, which can be purchased at any shoemaker's or harnessmaker's shop. You will also need a ball of harnessmaker's linen thread; a small ball of beeswax for waxing the thread, and several finger sticks of sizes to fit into the fingers of your gloves. These sticks can be whittled out of pine in a few minutes and smoothed off with a file and sandpaper. One end should be rounded, and they should be 5 or 6 inches long.

To Repair a Rip in a Leather Glove Finger, if the seam is inside, place the rounded end of the finger stick against the finger end. (See *Fig. 200.*) Keeping the other end of the stick against your chest, seize the glove finger with the forefinger and thumb of each hand and peel the leather back over the stick, thus gradually telescoping the finger or turning it inside out.

When the trick has been fully accomplished, you

will have the seam on the outside, where you can get at it for sewing.

Various stitches can be used in repairing the rip, but the two best ones are shown in *Fig. 201*. Start back

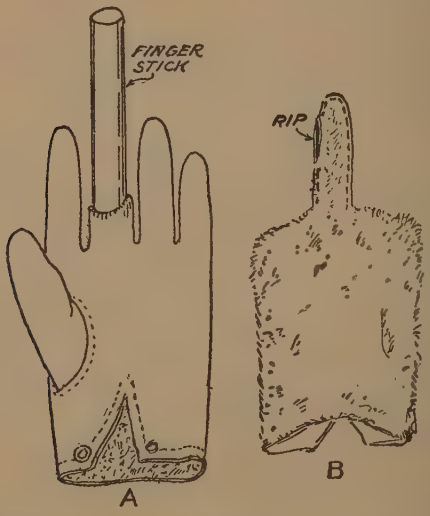


Fig. 200. Sewing a Ripped Glove Finger.

into the good sewing, using a very small knot, and finish by going a little way into the good sewing at the other end, likewise knotting there.

When the stitching has been accomplished, turn the finger back again to its natural position, using the stick in the same way.

To Sew Other Rips in Gloves, as in the hand portion, you can turn out the seam without the aid

of the finger sticks. The stitching is done in the same manner, or with a sewing-awl like that in *Fig. 192*.

If a Snap-button Tears Out of a Glove, as it sometimes does, cut out a small disc of leather from the upper of an old shoe, or from another glove, and sew this on the inner side, over the torn buttonhole, using close stitching. Through the patch make a new

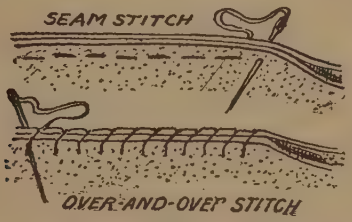


Fig. 201. The Two Common Stitches Used in Hand-sewing Gloves.

hole for the admittance of the button's neck. Pry open the clinching prongs, insert the neck, and then clinch the prongs over the leather. You can then once more button up the glove as well as ever.

To Keep Leather Working-gloves Soft, rub them once in a while with neatsfoot oil, which can be purchased at any drug store. This will also make them water-proof.

XXII

CONCRETE REPAIRS AND REPLACEMENTS

THERE are many things about the city home or farm premises which, if made of concrete, can be readily and lastingly repaired, and which, if not made of concrete, can be replaced to decided advantage with similar constructions made of this very sturdy composition.

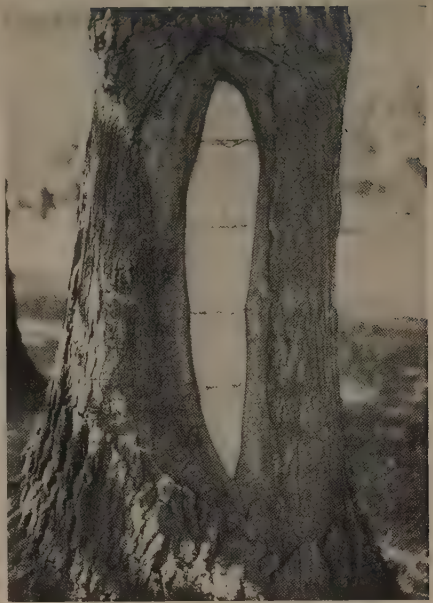
The following list is suggestive of the many improvements around the home for which concrete is particularly suited:

Basement floors, benches, cisterns, clothesline posts, gate posts, fence posts, rural mailbox posts, cold frames, driveways, sidewalks, flower boxes, foundations, garages, hotbeds, sandboxes, laundry tubs, walks, steps, porches, porch piers, foundation piers, septic tanks, tree surgery, well curbs and covers, and weights.

Most of these articles will be treated in this chapter; those not specifically dealt with will not be difficult for you to repair, replace, or make, after studying the general instructions herein given for doing concrete work.

Concrete is made by mixing Portland cement, sand, pebbles or broken stone, and water, in certain proportions, according to the kind of work done, and then permitting the mixture to harden in forms or molds. When thus cured, it becomes as hard as stone and almost as lasting. You will note, however, by

DON'T LET YOUR TREES GO ON DECAYING LIKE THIS, BUT—



STOP THE DECAY BY FILLING THE BREACH WITH CONCRETE LIKE THIS

reference to *Fig. 202,* that 1 cubic foot of cement, 2 cubic feet of sand, and 4 cubic feet of pebbles, do not make 7 cubic feet of concrete, as most of us would think, but 4.5 cubic feet.

In the mixing, the stone and sand are used in such sizes and proportions that the amount of spaces or voids between the particles is as small as possible, and care taken that all the surfaces of the sand and pebbles

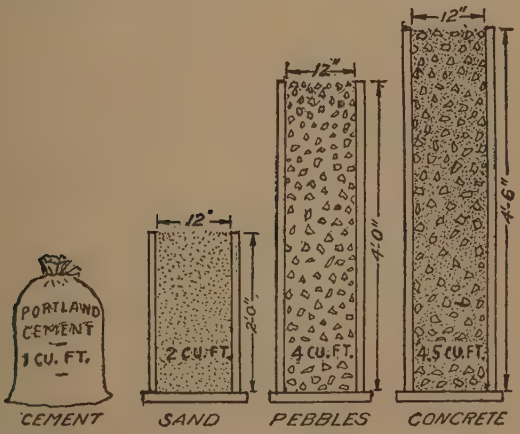


Fig. 202. The Relative Results of Mixing Together Concrete Ingredients.

are coated with a film of cement. The smaller the voids, the stronger and the more dense will be the concrete when hard.

Water-tight Concrete, in fact, is of such a fine mixture that practically no voids exist. This does not mean that the wall is dense throughout its thickness; for that would not do, as sufficient fine sand and fine

gravel to accomplish this purpose would render a tank or well too weak; it means, however, that the wall is first made of a medium-coarse mixture, after which its surfaces are coated with a mortar made from fine sand and cement, this wash filling all porous spots in the wall and rendering the structure water-tight.

Portland Cement is manufactured by grinding up and mixing together definite proportions of limey and clayey earthen matter, subjecting these to intense heat that causes them to cohere into a sort of clinker or slag, then grinding up the clinkers until they are reduced to a grayish, flour-like powder.

The cement is packed and shipped in standard-sized cloth bags or paper sacks, each holding 94 pounds net. For convenience in determining the necessary quantity of the several materials entering into a concrete mixture, a sack of Portland cement is generally considered as 1 cubic foot. (See *Fig. 202.*)

All building material dealers handle Portland cement, and most of them also sell sand and gravel for making the mixture, although if you live near a sand or gravel strata of the proper grade for your work, it is likely you can buy to advantage from the owner of such property.

Cloth bags are charged against the cement purchaser. When empty, therefore, money can be saved by returning them to the dealer. Paper bags are not returnable.

Cement should always be kept in a dry place; dampness will cause it to cake and become ruined.

Aggregates is a term applied to the sand and pebbles or broken stone that are used as a binder in all

concrete work. Sand is called "fine aggregate," and pebbles or crushed stone are called "coarse aggregate." Sand and other fine aggregate, such as crushed rock screenings, includes all particles from very fine bits (exclusive of dust) up to those which will just pass through a screen having meshes ¼ inch square. Coarse aggregate includes all pebbles or broken stone ranging from ¼ inch up to 2 inches.

Sand should be clean and hard, free from fine dust, dirt, or vegetable matter, such ingredients causing the concrete to harden slowly and adhere poorly. It should be well graded; that is, it should have fine, medium, and coarse particles in it, as this makes a tougher binder.

Bank-run Gravel contains a natural mixture of sand and pebbles. It is not suitable for concrete unless first screened so that the sand may be separated from the pebbles and the two materials proportioned correctly.

Concrete Mixtures, as stated before, should be made up very carefully and with due regard for the nature of the job in which they are to be employed. The various proportions are commonly designated by figures, with colons separating the ingredients, cement being placed first, sand placed second, and pebbles or crushed stone placed third. Thus, a mixture marked 1:2:3 means 1 sack (1 cubic foot) of cement, 2 cubic feet of sand, and 3 cubic feet of pebbles or crushed stone. A 1:2 mixture means 1 sack (1 cubic foot) of cement and 2 cubic feet of sand. Such a compound would really be a mortar, since it contains no coarse aggregate.

Table of Recommended Mixtures with Maximum Sizes of Aggregates

		Max. Size Agg.
1:1:1½	—Mixture for:	
	Wearing course of two-course pavements	¾ in.
1:2:3	—Mixture for:	
	One-course walks, porch and basement floors, pavements and steps	1½ in.
	Basement walls exposed to moisture	1½ in.
	Fence posts and other posts, benches	¾ in.
	Sills and lintels, without mortar surface	¾ in.
	Wells, troughs; other water containers	1 in.
1:2:4	—Mixture for:	
	Foundations for farm machinery	2 in.
	Concrete work in general	1½ in.
1:2½:4	—Mixture for:	
	Coal bins, grain bins, silos, sand boxes, building walls above ground, basement walls, hotbed walls, etc.	1½ in.
	Base of two-course floor or pavement	2 in.
1:2	—Mixture for:	
	Wearing course of two-course floors, walks, pavements, also flower boxes	¼ in.

The Tools Commonly Required for concrete work are simple and most of them can be made at home. (See *Fig. 203.*) They include the following:

Screen, mixing platform, shovel, measuring box, pail, tamper, spading tool, strikeboard, wood float, steel trowel, edger, groover, and wheelbarrow.

The Screen is not a necessity if you can get your dealer to supply you with aggregate properly graded,

as you very often can do. If unable to do this, it will be a good plan either to borrow the screen of a concrete worker, else make one yourself.

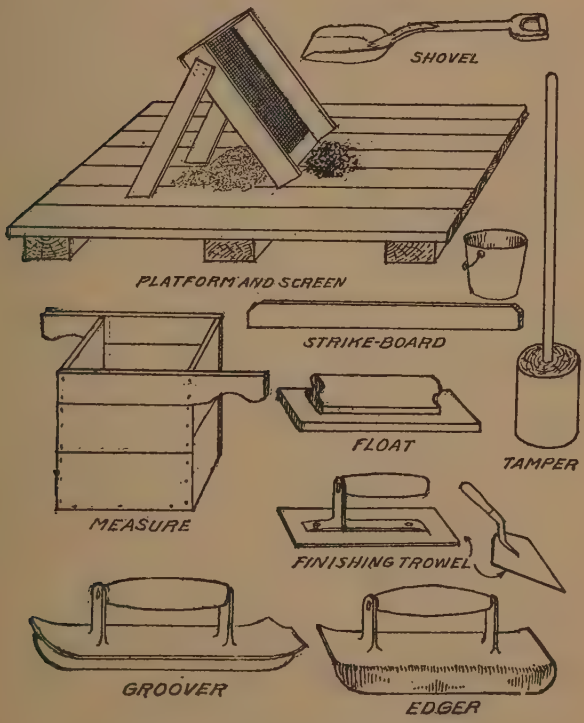


Fig. 203. Tools for Home Concrete Work.

A regulation screen is about 6 feet long and 3 feet wide, formed of a framework of 1½-inch boards 5 inches wide, the bottom covered with a screening hav-

ing meshes ¼ inch wide, the entire frame supported by legs which bring it at a slant of about 45 degrees.

For ordinary home work, however, a smaller screen will do just as well, such as that shown in *Fig. 203*. This can be cut down from the sides of an old packing box, so that the frame will be about 3 feet square, and strips can be nailed on at an angle as a means of support. The screening can be obtained at a hardware store or of a dealer in building supplies.

A Mixing Platform of simple type can be made by using a piece of sheet steel about ⅛ inch thick, resting this upon 2 by 4's, to which it is fastened. An even more simple arrangement, when it is to be had, is to utilize the natural surface of a concrete driveway or floor.

If nothing so promising as these two devices offers itself, the best thing you can do is to make a mixing platform out of boards, such as shown in *Fig. 203*. The floor should be made of 1½-inch lumber, tongued and grooved, and surfaced on the upper side where the mixing is done. Underneath, fasten three or four stringers of solid proportions.

A Measuring Box, or a substitute, is a necessity, for every batch of mixture must be correctly proportioned if success is the outcome. A common pail will do for the purpose, but a regulation measuring box is so easy to construct that it will pay you to make one, fashioning it after the suggestion in *Fig. 203*. Get your material from an old packing box if nothing else is available. Have the joints tight, and cut the upper side boards long enough to project and form handles. The box is bottomless; its inside dimensions should be

12 inches long, 12 inches wide, and 12 inches deep. Such a receptacle, when set on the platform and filled with aggregate, will hold exactly 1 cubic foot of material or 1 bag of cement. As fast as filled, the box is lifted up, leaving the material on the platform, to be pushed into the main pile, whereupon the box is replaced and refilled.

The Tamper (*Fig. 203*) is used for packing down the loose mixture in a form and making it as compact as possible. A very good one can be made from the end of a bolt or log, or by using a good-sized square block, into which a hole is bored to receive a handle. The handle can be taken from a snowshovel, pitchfork, or heavy broom that has become worn out.

The Spading Tool is used for punching up and down along the faces of a wall form, as it fills, in order to push back large pebbles which would otherwise appear on the outside of the finished concrete, also to aid the tamper in forcing down the mixture and rendering it free of air-pockets. A good spading tool can be made by flattening out an ordinary garden spade, then cutting out portions of the metal so that it is slotted. A garden hoe, straightened out, will also often do.

The Strikeboard is merely a piece of board about 1½ inches thick, and long enough to reach across the top of the forms, as in sidewalk construction (*Figs. 203* and *204*), so that the top dressing of concrete can be scraped off level before final finishing.

The Wood Float (*Fig. 203*) is used to smooth the surface of concrete after it has been struck off or scraped with the strikeboard. It can easily be made

from a block of wood ¾ x 4 x 10 inches, to which is fastened another block for a handle. To the bottom, fasten a piece of sheet metal, if you want the smoothest results.

A Finishing Trowel, or steel hand float (*Fig. 203*) may sometimes be required where the wood float does not leave a smooth enough surface, but if the wood float is faced with metal in the manner suggested, the finishing trowel will not be needed. For small jobs, a common garden trowel, as illustrated, may be used.

The Groover (*Fig. 203*) is used in floor and pavement work, for running grooves in the concrete, such as the squared marks you will notice in such constructions. These lineated depressions are only semi-decorative, their chief purpose being to cut through the concrete mass sufficiently to allow the segments to separate uniformly should frost conditions or root growths insist upon breaking the layer somewhere, as nature often does.

The Edger (*Fig. 203*) will also probably have to be bought if you have need for one. This tool has its fin along one edge instead of in the center, as with the groover. It is used for smoothing off the ragged edges of the slabs of concrete sidewalks, driveways, and the like.

Forms for Concrete Work are not always required, inasmuch as constructions are often made in such a way as to utilize the earth, and other natural or ready-made objects, for retaining the mixture in shape until it sets or hardens. But, in most cases, the workman finds it necessary to make one or more forms be-

fore he can go ahead with any piece of concrete construction. Such forms are produced from various materials. As a general thing they are made from boards, although sometimes of metal, and even of plaster-of-Paris. Most of the building blocks are made in cast-iron forms, various patterns of which you can buy from dealers in building materials or from big mail-order houses.

Bear in mind that no concrete object can be truer in shape than the mold in which it is held while drying. For this reason great care must be used in making the form. As a rule, small ornamental objects, such as flower boxes, require more attention to detail in the building of forms than with larger subjects, such as the walls of buildings. Bracing, and portions of forms which do not come in contact with the concrete, may be very roughly placed, of course. It is the touching portion that must be smooth, free from cracks and knot holes, and generally in good condition.

The best results come from soaking the form pieces, after cutting out, in crude oil. This treatment preserves the wood from moisture, prevents warping, and keeps the concrete from sticking to the form. However, fair work can be done without the oil.

The pieces of a form should be heavy enough, and well enough braced and fastened, to prevent the weight of the concrete mixture, when placed in the form, from bulging it. Use wood screws for fastening together the parts of light ornamental forms; nails for rougher small forms; nails, bolts and threaded rods for larger forms.

After use, clean the pieces of your form very

thoroughly, if you intend to use it again. Remove all particles of adhering cement, and see to it that the contact surfaces are again in smooth condition.

Concrete Reinforcement is often necessary in order to give adequate strength to the finished object for the purpose to which it is to be put. For instance, all posts and other extended surfaces, which are not supported by surrounding objects, and which are put to a considerable strain, would not be strong enough from their native composition to withstand the normal stress; therefore, some stiffening agent other than concrete mixture must be incorporated in their structure.

Such reinforcing agents come in two common forms: wire mesh (*Fig. 209*) and steel rods (*Figs. 209* and *211*). The mesh is used mostly in small circular formations, where it is difficult to bend the rods, and the rods are used where the mesh is not applicable. Where the rods are too long for a certain service, it is easy to sever them with a hack-saw; where not long enough, it is customary to lay them end to end, with a lap of several inches. They should never come very close to the surface laterally, for loss of rigidity would be the result.

When Mixing Concrete, small repair jobs can be taken care of more economically by hand-mixing; but if you need a comparatively large quantity of concrete, as in replacing an old barn foundation wall made of wood with one made from artificial stone, a machine-mixer will do the mixing more uniformly and with a great saving of labor. A platform, screen, and measuring box, for hand-mixing, has been previously described in this chapter.

In Hand-mixing, first measure out the required amount of sand, as at *1, Fig. 204.* Spread this out on the platform and pour over it the required amount of sand, as at *2.* With shovel or hoe, turn over this mixture until it is thoroughly mixed and of a uniform color, as at *3.* If coarse aggregate is desired, add pebbles or broken stone to the right proportion. If fine aggregate is desired, hoe a hollow in the center

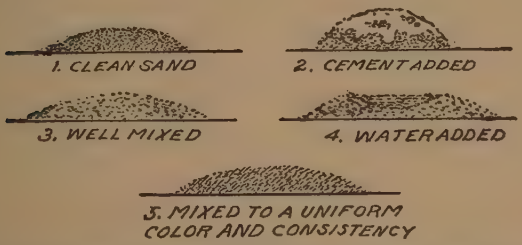


Fig. 204. Steps in Making Up a Batch of Fine Aggregate for Concrete Work.

of the sand-concrete mixture, then put in a little water, as at *4.* Mix this in, adding more water when required, until the mixture is of a quaking, jelly-like consistency. Too much water will cause a shrinking, weak, uneven concrete form.

Use either a shovel or a pail for pouring the mixture into the forms, and have such forms ready before preparing the mixture, for the latter should never stand long before being used.

The tamper, the spading tool, wooden strips with beveled ends, also rods, can be used in packing down the mixture until it is as compact as it can be made.

When the Forms Are Filled, the mixture must be given proper protection as it hardens. In wall work, the top only will be exposed to the weather; this portion should be covered with straw, tar-paper, canvas, burlap, or something similar, if rains or snows threaten. In flat work, such as sidewalks, driveways, and floors, similar precautions should be taken, and a rough framework or railing erected to keep out animals and warn off people.

The Hardening of Concrete requires a varying length of time, dependent upon mixture and weather conditions. In summer, sidewalks will often dry for use in five or six days; in the cold days of winter, a much longer time will be required, possibly two weeks.

When Doing Concrete Work in Cold Weather, extra precautions must be taken. Then it is necessary to heat the sand and pebbles and to use lukewarm water, so that when the mixture is prepared it will have a temperature of approximately 80 degrees. It must then be placed in the forms very quickly, and the whole covered with straw, burlap, or tar-paper, to retain the heat as long as possible.

Surface Finishes for Concrete can be produced in quite a variety. Some of these finishes are applied after the foundation is formed, while others are partly arranged for when the mixture materials are being selected.

Plain Surface Finish, the simplest of all, is produced by ordinary drying after the pebbles have been spaded back so as to leave an outside film of sand and concrete.

Cement-water Wash Finish consists of painting the concrete with a cement wash, usually made up of 1 part cement and 1 part fine sand, mixed with water to form a sort of paint. This is applied with a brush after the forms are removed. It is not a very reliable finish, as it is likely to hair-check and scale off in spots.

Floated Finish is applied after the forms are removed and the concrete has set enough to have become self-sustaining. Ridges caused by joints in the forms are carefully chipped off, the concrete surface is made wet, then rubbed with a carborundum stone. This rubbing in water removes the inequalities, fills the pores and small cavities, and gives to the surface a smooth, uniform appearance.

Selected Aggregate Finish is usually identified with small ornamental objects, such as flower boxes and bird baths. The aggregates are especially picked out for their beauty and novelty and consist of various minerals, among which are marble chips, granite screenings, crushed feldspar, mica scrap, crushed slag, garnet sand, and white sand. These aggregates are prepared and mixed with cement in the usual way. When the concrete has hardened so that forms may be safely removed, the surfaces may be brightened up by polishing the visible bits of mineral with water and carborundum stone.

Combinations of Colored Aggregates also make a very pleasing finish by placing each kind in its own particular part of the form.

Polished Finishes in concrete are obtained by using as little cement as possible and by carefully grading the aggregate, the object being to expose a maxi-

mum of very closely massed aggregate. Before the concrete is extremely hard, rub it to a high polish by using water and a carborundum block.

Colored Pigment Finishes are produced by adding colored matter to the cement. For example, if you wish a uniform reddish tone for a surface finish, coloring matter such as red oxide of iron may be added to the cement, and pink or red granite chips used as an aggregate. The resulting concrete form is then polished in the ordinary way, sufficiently to expose the true surfaces of the aggregates.

Stucco Finish is a sort of plaster-laid film upon the concrete. Stucco should be proportioned thus: 1 sack of cement, 2 cubic feet of sand, and sufficient hydrated lime to equal one-tenth of the cement. First, mix together the dry cement and hydrated lime, then add clean sand and thoroughly mix to a uniform color. Add sufficient water, stirring it in, to create a good mortar. The mixture should be wet enough to smooth out easily under the trowel, but stiff enough to keep from running.

In the construction or repair of buildings, usually two or three coats of stucco are applied. The first coat must be roughened, before drying, by scoring it with a toothed stick, so that there will be a good bond for the second coat. The second coat is also scored if a third one is to be applied. Quite a variety of finishes can be given the final coat. The simplest one is to trowel the surface to a moderately smooth condition. Too much troweling will tend to produce a finish that will crack.

Stucco should not be allowed to dry out rapidly.

If exposed to the sun, hang a covering over it, else keep it wet down for the first few days by a moderate sprinkling with a hose.

A batch of stucco, in which 1 sack of cement is used, will cover about 17 square feet.

Rough-cast Finish can be obtained in stucco by using a trowel covered with carpet or burlap. In this case, previously prepare your mixture with a slight excess of sand, and have a minimum amount of water in it.

Slap-dash Finish for stucco is secured by throwing on the final coat with a wood paddle. This requires a little practice, but after the knack is acquired you can produce a very attractive surface.

Pebble-dash Finish is obtained by throwing clean pebbles into the fresh stucco of the final coat. These pebbles should be about ½ inch in their greatest dimension, and be as uniformly round as possible. They are dashed on when wet, and if their natural color is not to show, it is best to coat them with cement-water paint, which will make them stick even better.

Patching Jobs often arise about the modern home where concrete work exists, and sometimes, indeed, concrete can be used to fine patching advantage on objects that are not themselves made of this material.

To Patch Up Sidewalks, Steps, Floors, Etc., which have crumbled internally, the process is to clean the cavity thoroughly, removing all loose material; then saturate the old surface with water to the degree that it will absorb no more moisture. If the edges of the hole are shelving, so they are likely to receive only a thin filling of new concrete, chip them away, giving a

distinct undercut, as this will provide the best sort of anchorage for the new material. Then mix up the repair batch, using the same proportions of materials as used in the old job. (See table of Concrete Mixtures.) This will insure uniformity of color when dry.

To Do Edge Patching in Sidewalks, Steps, Etc., proceed in the same way as for interior holes, except that here it will be necessary to build up a form on the open side or sides. If reinforcing wire mesh is used, the repair will be doubly strong.

To Fill Decayed Trees (see *photographs,* 340) with concrete, is one of the best ways in the world to prolong the lives of arboreal specimens affected by visible rot. No shade tree, particularly, should be allowed to go on living with a breach in its trunk—a breach offering ready admittance to destroying moisture and attacking insects.

Clean out such openings very thoroughly, removing all dead wood around the aperture. If the cavity is small, the concrete can be filled directly into it; but if it is a large opening, such as one communicating with a decayed vertical bore, you will need to prepare a cage for the mixture. The latter is made from fine-mesh screening nailed across the bottom of the hole inside the tree. If the screening is unavailable, use pieces of board for a covering—anything that will prevent the mixture from going down in a portion of the tree's trunk where it will be utterly wasted.

Make up a 1:1:1 mixture as a filler. If the exterior opening is long—say 12 inches or more,—you will have to produce a flexuous condition of the concrete by laying it in sections, with sheets of linoleum

or thin metal between, like shelves in a bookcase. This method is quite necessary, because, were the concrete in one solid mass, it would crack and crumble out when high winds blew and bent the tree.

Before the concrete is hard, trowel on a 1:1 mortar of sand cement, carefully filling all crevices, so that no insect can possibly get to the interior, and in a manner to seal the opening so that it will be practically

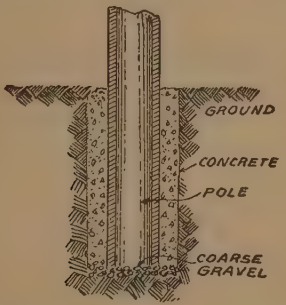


Fig. 205. To Set a Pole or Post in the Ground with a Protective Concrete Casing Around the Upright.

water-tight. The concrete can then be painted, if desired, to match the tree.

A Concrete Foundation for a Pole or Post is made in the manner illustrated in *Fig. 205*. This is an especially good way of setting radio antenna poles in the ground, flag poles, clothes posts, and the like, whether of metal or wood, for they are held firmly and do not rust or decay as when in contact with earth itself. After the hole is dug and its bottom lined with coarse gravel, the pole is set in and the concrete mixture tamped down around it. The walls should be

about 5 inches thick for most poles and posts, with a depth of about 3 feet.

Concrete Foundation Piers make a fine substitu-

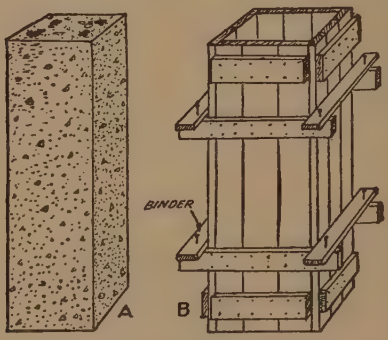


Fig. 206. Concrete Foundation Pier and Its Form.

tion for decayed wooden piers in old buildings otherwise good. They are easily made, are reinforced with

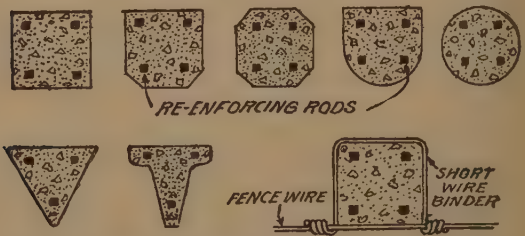


Fig. 207. Simple Forms of Fence Posts and Method of Attaching Wire.

four rods, and the form required is simple to construct. *Fig. 206* shows, at *A*, a finished concrete pier of square pattern, while at *B* of the same illustration is pictured

the necessary form. As many piers as needed can, of course, be made from the one form.

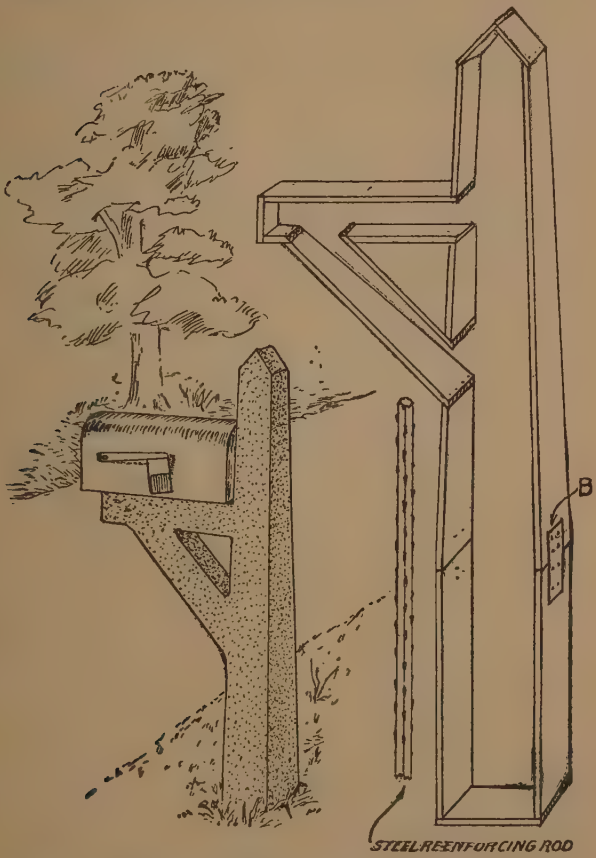


Fig 208. Pretty Concrete Rural Mailbox Post and Form for Making It.

Concrete Fence Posts or Gate Posts, in a wide variety of forms and sizes, can be made to supplant old posts of iron or wood that may have served their day. Suggestions of design are shown in *Fig. 207,* also a good method of stringing wire to such a post. All such posts should be reinforced with rods. The

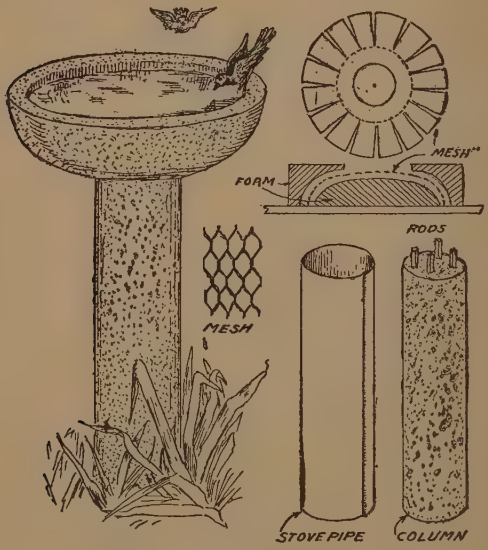


Fig. 209. A Concrete Bird Bath.

forms for flat-sided posts are made entirely of boards; round posts can be made in sheet-metal forms; posts with both flat and curved surfaces are made from forms composed of both wood and metal.

A Rural Mailbox Post (*Fig. 208*) of very attractive design, and a post that will give lasting service,

as well, can be turned out in a short time by any one handy enough to make the form shown in the drawing. Not less than four reinforcing rods should be built into the concrete standard, with two in the arm section and also two in the angular supporting bracket. The post is set directly into the ground, and dirt and gravel are tamped around it.

A Concrete Bird Bath (*Fig. 209*) can have its standard made out of a form adapted from so simple a thing as stovepipe. Reinforcing rods should be left

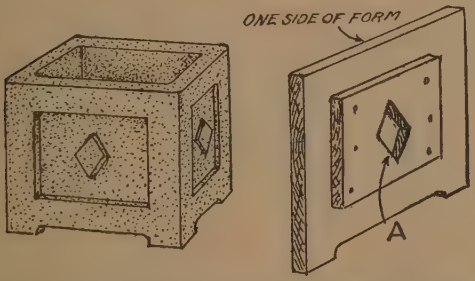


Fig. 210. An Attractive Flower Box of Easy Construction.

projecting at the upper end, to engage the bowl section. The bowl form is made in two parts, as shown, and is set over the projecting rods. As the concrete mixture is filled in the bowl form, a disc of reinforcing metal mesh, previously cut to the pattern illustrated, is worked in.

Such a bird bath will prove a great improvement over the old board shelf and tin pan you may have had fastened to the side of the garage or barn.

A Concrete Flower Box (*Fig. 210*) has a form composed of four sections or sides made of pieces of

board. Through the smaller section of each side, a diamond-shaped hole (*A*) is cut. The sides are held together by lapping outside strips similar to those shown in the form of the foundation pier form in *Fig. 206*. An inside form, in the shape of a box, is also required.

A Concrete Water Trough (*Fig. 211*), such as might find use on the farm for watering hogs or other

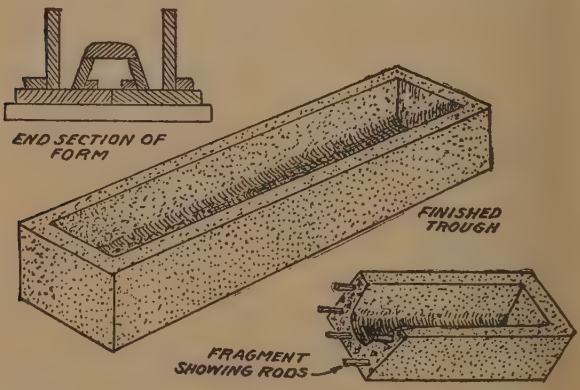


Fig. 211. Details for Making a Concrete Water Trough.

stock, is reinforced in the manner illustrated, and is moulded in a wooden form made after the plan drawn.

A Concrete Sidewalk (*Fig. 212*), **Driveway, or Floor** are all built after the same principle. I am illustrating sidewalk construction only for, after all is said and done, a driveway is merely a very wide sidewalk, and a floor is in its essentials nothing more than a number of sidewalks placed side by side.

This sort of concrete construction, which I may term

platform work, should rest on a firm base. If the soil is well drained, the concrete can be placed directly upon it; but, first, all loam, refuse, grass, roots, and other perishable material, must have been removed and the area been well tamped or rolled down. If the soil is not well drained, a sub-base should be provided;

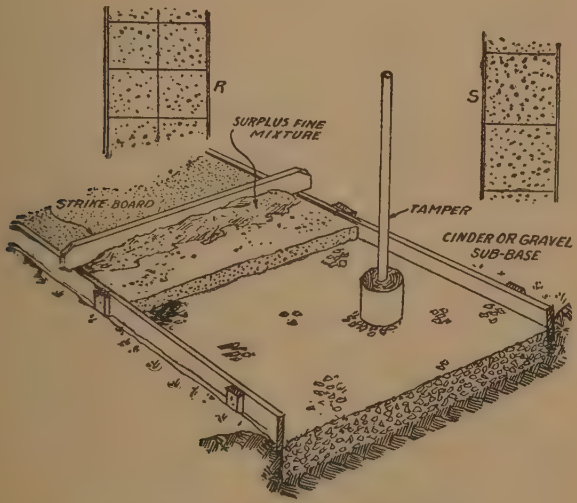


Fig. 212. How to Make a Concrete Sidewalk.

this must be of clean, coarse gravel, packed closely, or clean cinders.

Usually, 2 by 4's, securely staked in position, are used as side forms for walk construction.

Floors are laid either as one-course or as two-course construction. One-course construction signifies that the full thickness of the pavement is placed at

one time, using one standard concrete mixture throughout. Two-course construction means that the pavement is laid in two sections, a certain mixture being used for the base and another (usually a mortar) being used for the top or wearing surface. One-course construction is generally the more satisfactory of the two.

Good walks and floors are blocked off with partition strips. In filling these spaces with mixture, one space is skipped each time. When the filled spaces have cured or hardened, the partition strips are removed and the open spaces between the concrete slabs are then filled with mixture, thus completing the continuity.

The thickness of walks may vary from 4 to 6 inches, according to width and the weight they must carry; pedestrian service requires not more than 4 inches; wagon service requires 6 inches.

Enough water should be used in the mixture to produce a pasty consistency, so that it can spread out in the forms and be easily leveled with the strikeboard resting on the edges of the forms. This strikeboard should be drawn across with a saw-like motion, a movement which will more evenly level the surface than if the tool were to be drawn straight along the forms.

To produce an even, gritty surface, the platform is then finished with a wood float.

Concrete Foundation Walls are of two types—those made of concrete cast in place and those made of precast units known as concrete blocks. Both types have proved satisfactory. Walls made of the blocks

are usually less expensive, but, where loads are very heavy or cellars very deep, solid concrete walls are preferable.

Under the walls of residences and barns a footing should be placed, to give the walls a firm seating. The average barn will require a concrete footing 2 feet wide and 12 inches deep. Small residences will require footings 18 inches wide and 12 inches deep. For small farm buildings, such as poultry-houses and milk-houses, footings should be 12 inches wide and 8 inches deep.

Concrete foundations for buildings should be strong, water-tight, and permanent. They should extend down to a firm soil, so that there will be no danger of the structure settling; they also should go past the frost point, to prevent frost upheaval.

Try to start the walls early enough to insure their completion the same day, as this will save construction joints. If you cannot finish at one period, bring the concrete to a level in the forms as high as you have built them, and roughen the top surface with a trowel, else stick in pebbles so that they will project. Next day, extend your forms; coat the top surface of the concrete with a mortar of cement and water, and then place in the new concrete mixture.

Laying Out a New Foundation is easiest done by means of a very simple and practical system known among carpenters and builders as the right-triangle method. Any triangle with sides 6, 8, and 10 feet long is a right-triangle, and the 6- and 8-foot sides will be at right angles with one another and will correspond to two perfect sides of a square or rectangle,

such as required for the foundation lines for the ordinary building.

Fig. 213 gives a graphic idea of laying out foundation lines by this right-triangle method. First, establish a base line (*AB*) by marking out one end or side of the proposed building. Set stakes at each end of the line, thus locating two corners. Drive nails partly

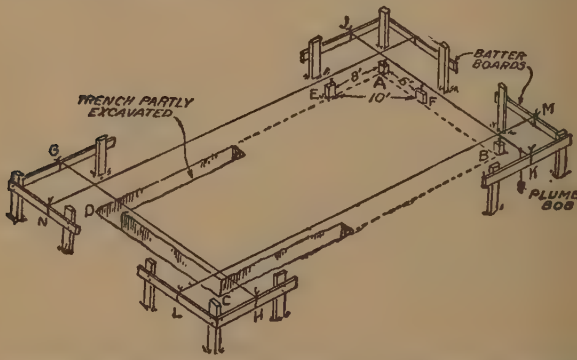


Fig. 213. The Method of Laying Out Foundation Trenching Lines.

in the tops of these stakes. On the line *AB*, 6 feet from *A* nail, drive the stake *F* and also place a projecting nail in the top of the latter stake.

Stake *E* should be placed so that its center will be exactly 8 feet from stake *A* and exactly 10 feet from stake *F*. The corner represented by the angle *EAF* is a right-angle; the line *AE*, extended to *D*, will form the second boundary line of the building, and *D* will represent the third corner. Other corners are found in the same manner.

A rough triangular framework is next established

about 1 foot beyond the corner stakes. This is done by driving in three longer stakes and joining them with batterboards *J-P, K-M, G-N,* and *L-H,* which are placed at the floor level or any other convenient setting. Strings are run from one batterboard across to its opposite corresponding batterboard so that these lines will be directly above the nails in the corner posts of the foundation outline.

Ground lines are projected from the strings by suspending a plumb-bob from them to the soil, at points close to the batterboards. Stakes (not shown in the diagram) are then set at these points, and strings, very close to the ground, are made to connect them in straight lines.

Inasmuch as the final boundary lines are then established, the stakes *A, B, C, D, E,* and *F,* with their strings, should be removed so that they will not interfere with excavating the trench. The triangular frames at the outer corners, however, are left standing, but the strings connecting them are removed after nails have been driven in to indicate where the strings join the batterboards. This is done so that new ground lines may be easily run should the first ones have to be removed or become accidentally broken.

Having thus found the true building lines, it is a simple matter to proceed with the trenching, to locate piers, posts, or other intermediate supports.

Foundations from Earth Forms are the most simply made foundations of all. They are used in connection with small buildings having no basements, and where the soil is so firm that a trench of the proper depth and size will serve as the walls of the forms.

Excavate carefully, so that the walls will be even and vertical.

In spading and tamping down the mixture, be careful not to knock any loose earth into the concrete. Planks placed alongside the trench will help to protect the edges in this respect, and will provide a convenient runway for a wheelbarrow.

In soft ground a board lining will be required.

A Foundation for a Garage or similar small structure that requires wood sills must be provided with protruding bolt ends, as at *A, Fig. 214,* so that such

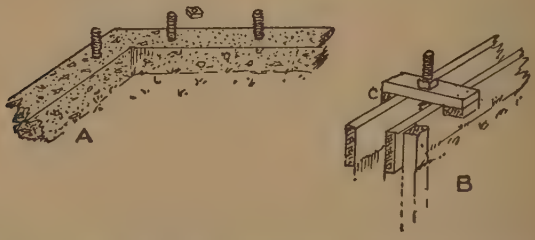


Fig. 214. How Sill Bolts Are Put in a Concrete Foundation.

ends may pass up through the sills and the latter confined by nuts securely wrenched down upon washers. The diagram at *B,* of the same figure, shows clearly how the inverted bolts are held in position while the concrete hardens about their headed portions.

Foundations from Semiearth Forms (*Fig. 215*), such as where there is a basement, may be made by building, on the inside, a form like that illustrated, and by using the earth for the outer form.

If the walls are to rise above the ground, board forms on both sides are required for the clearance.

A Concrete Sand Box (*Fig. 216*) will keep the children pleasantly engaged out of doors, and may be

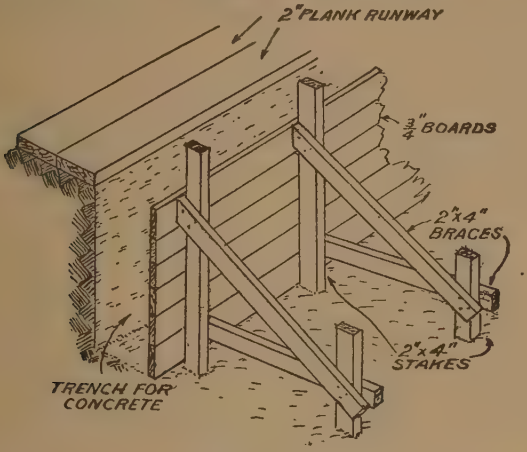


Fig. 215. Forms for Foundation Walls Where the Embankment Serves as the Outer Form.

turned into an attractive flower bed, duck pond, or aquarium when the children grow up. Its construction

Fig. 216. Convenience of a Concrete Sand Box—a Delightful Play-place for the Children; a Fine Plant-bed when they Grow Up.

will be obvious after reading the general instructions already given in this chapter.

A Concrete Hot Bed (*Fig. 217*) is useful in both city and rural communities, where there is a little back-yard space. General directions already given cover the essential points of the concrete construction. Have the walls 6 inches thick and put them 3 feet in the ground. The north wall projects 20 inches above ground; the south wall, 8 inches. A mill or carpenter will make the glass frames.

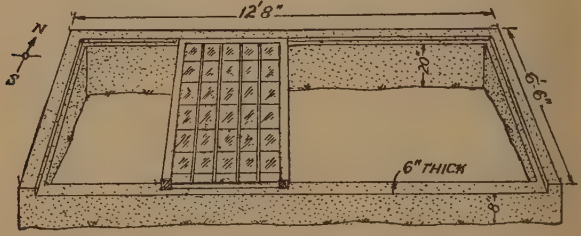


Fig. 217. Concrete Hot Bed, for City or Rural Use.

Well rotted manure is placed in the bottom of the excavated interior to a depth of 2 feet, and is covered with an 8-inch dressing of rich soil.

Concrete Steps (*Fig. 218*) are safe, non-slippery in wet weather, and are the finest kind of a replacement for old wooden steps that have rotted out. Simple forms, such as shown in the drawing, will do for the average job of this kind. A 1:2:3 mixture is standard for the purpose. Finish off with a wood float.

A Concrete Well or Cistern (*Fig. 219*), with concrete platform, is sanitary, vermin-proof, and lasting. In shallow wells, the wall often runs from top to bottom; in deeper wells, also in repairing old wells, a wall

extended down 6 or 8 feet will ordinarily give the required protection against surface pollution.

The drawing shows, at *A* and *B*, an easily constructed form for the walls. No outer form is needed if the earthen sides are firm and smoothly dug. The wall form is made up in four sections, and the vertical boards should be beveled at their edges so as to make a close union with one another. Have them not wider than 3 inches. Alternate sections are provided with

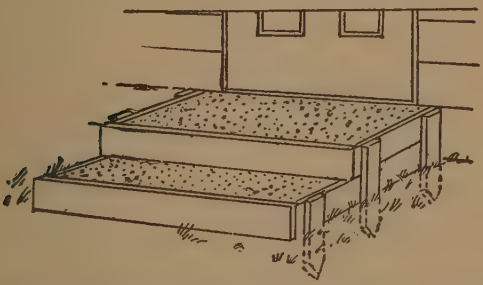


Fig. 218. Manner of Making Simple Concrete Steps.

cross-board reinforcements whose ends project and lap shorter cross-boards attached to the meeting sections. These laps are bolted together.

The wall forms, when assembled, should not fill the excavation of the well, but should leave a clear space of about 4 inches all around between it and the earthen wall. In this space, pour in and tamp down a 1:2:3 concrete mixture. Remove the forms as soon as the concrete becomes self-supporting, and construct the platform forms.

A standard method of making such forms is illustrated in the sectional view, *C*. A manhole is pro-

vided by setting an ordinary dishpan on the form at the proper place. A concrete cover, to fit this opening, is made by casting it in the dishpan. To form a hole

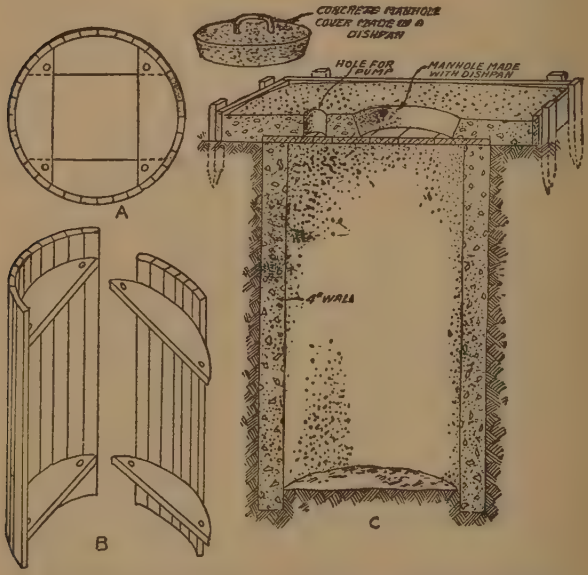


Fig. 219. How to Make a Concrete Well or Cistern.

for the pump, make a cylinder out of a strip of tin and set it on the board decking of the form, withdrawing the cylinder when the surrounding concrete has cured sufficiently.

Use the same mixture for the platform as for the walls of the well. This platform should be about 6 inches thick, and ought to be reinforced either with wire mesh or ¼-inch rods, so placed as to give the greatest strength where required.

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